Acta Dermatovenerol Croat 2021;29(3):148-153 REVIEW

Maskne: A New Entity in the COVID-19 Pandemic

Ayla Hadžavdić[1], Zrinka Bukvić Mokos[1,2]

[1]School of Medicine University of Zagreb, Zagreb, Croatia; [2]Department of Dermatology and Venereology, University Hospital Centre Zagreb, Zagreb, Croatia

Corresponding author:
Prof. Zrinka Bukvić Mokos, MD, PhD
School of Medicine, University of Zagreb
Department of Dermatology and Venereology,
University Hospital Centre Zagreb
Kišpatićeva 12
10000 Zagreb
Croatia
zrinka.bukvic.mokos@kbc-zagreb.hr

Received: August 13, 2021
Accepted: October 1, 2021

ABSTRACT The term "maskne" has been coined during the ongoing COVID-19 pandemic, designating acne associated with prolonged protective mask-wearing. Maskne is a variant of acne mechanica caused by mask-induced mechanical injury (pressure, friction, and rubbing) and occlusion. The additional factors influencing the onset of maskne include genetics, environmental factors, duration of mask-wearing, the type of mask, and previous facial skin disease. The prevalence of maskne is increasing since masks are the most commonly used personal protective equipment in the general population. Furthermore, wearing masks in public tends to become the "new normal" even in the post-pandemic period. Hence, the problem of maskne could become even more significant. This review aims to provide a comprehensive view of current knowledge on prevalence, pathogenesis, prevention, and treatment of maskne.

KEY WORDS: maskne, acne mechanica, COVID-19, prevention, treatment

INTRODUCTION

Coronavirus disease 2019 (COVID-19) has become a global burden shortly after its first outbreak in December 2019 in Wuhan, China (1). Namely, COVID-19 was declared a pandemic on March 11, 2020 by the World Health Organization (WHO); by August 9th 2021, there have been 202,296,216 confirmed COVID-19 cases, including 4,288,134 deaths (2,3). The disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), mainly spread via respiratory droplets. The clinical manifestations vary from mild to severe respiratory disease with possible complications such as acute respiratory distress syndrome (ARDS), cardiac complications, secondary bacterial infection, and septic shock (4). However, some people may remain asymptomatic and able to spread the infection (5).

The main purpose of public health measures is to prevent the transmission of the virus from human to human. The use of personal protective equipment (PPE), physical distancing, and hand washing are essential preventive measures that have proved their efficacy, and their significance has not been abated even with the vaccine rolling out (6,7).

Masks are the most commonly used type of PPE in the general population. There are various types of masks, including surgical masks, respirators, and textile masks. Surgical masks are loose-fitting and do not prevent leakage around the mouth upon inhalation. They provide protection from large-particle droplets but not from tiny airborne particles. Respirators come in various filter options and are most commonly used by medical professionals since they protect from airborne hazards (8). In the USA, respirators are marked with the letter N (less commonly with R indicating resistance to oil or P designating strong resistance to oil) and a double-digit number (N95, N99, or N100)

Acta Dermatovenerol Croat
2021;29(3):148-153

depending on their capacity to filter particles 0.3 µm in size. For instance, N95 is able to filter at least 95% of the airborne particles with a size of 0.3 µm (8,9). In Europe, respirators are assigned as filtering facepiece respirators (FFP) which are classified by numbers 1-3 according to their filtering capacity (FFP1, FFP2, or FFP3) (9). The most commonly used types are N95 in the USA and FFP2 in Europe, which have almost the same filter capacity (>94%) (9,10). Cloth masks are made of different fabrics, including cotton (most commonly), silk, linen, lyocell, and synthetic fibers. They allow better breathability than surgical masks and respirators, but their protective function is much weaker (11). However, any type of mask can cause mechanical injury (pressure, friction) to the skin and the occlusion of the underneath skin. Consequently, prolonged use of masks may be associated with the onset and/or aggravation of several skin disorders, including acne, rosacea, and seborrheic dermatitis (12).

MASKNE: A VARIANT OF ACNE MECHANICA

The term "maskne" was coined in 2020, during the COVID-19 pandemic, designating acne that appears due to prolonged protective face mask-wearing (13).

Acne is a very common chronic inflammatory skin dermatosis which involves the pilosebaceous unit and most commonly affects adolescents and young adults (14). Pathogenesis of acne comprises the interaction of four main pathogenetic factors: hypersecretion of sebum by the sebaceous glands, abnormal follicular keratinization process (which leads to pilosebaceous duct obstruction), increased follicular colonization of the commensal, anaerobic bacteria *Cutibacterium acnes* (*C. acnes*), and host inflammatory response (14,15). *C. acnes* induces inflammation, mainly through activating the innate immune response, and acts on follicular keratinization and sebum secretion (14-16). The leading role in stimulating the sebaceous gland to sebum production is played by androgens, particularly dihydrotestosterone. In addition, androgens also stimulate intra-follicular keratinocyte proliferation (15). Clinical presentation of acne ranges from comedonal acne (the mildest form) and papulopustular acne to the most severe forms of the disease, including nodular and conglobate acne (14).

Prolonged mechanical injury, comprising friction, pressure, and skin rubbing, may lead to the onset of acne, which is called acne mechanica (17).

Acne mechanica was initially recognized by Mills and Kligman in 1975, who described this entity as acne exacerbations caused by mechanical stress, including friction, pressure, squeezing, rubbing, and stretching (18). Later, Dreno *et al.* suggested that the term "acne mechanica" should be used only in cases of acne flare-ups with a typical clinical and histological acne vulgaris profile which occurs due to mechanical injury to the acne-prone body areas (face, chest, and back). The term "folliculitis mechanica" was proposed for cases of inflammatory skin lesions caused by mechanical stress, which are present on areas of the body that are prone to acne or that are not, and which do not show a typical acne vulgaris profile (19).

Various precipitating factors for acne mechanica were identified, including sports-associated equipment (football shoulder pads and chinstraps), clothing (tight belts), occupational factors (rubbing of the back in professional drivers), backpacks, and music instruments ("fiddler's neck" and "flautist's chin") (18,20-22).

The association between acne and prolonged use of protective face masks has been observed even before the onset of the COVID-19 pandemic (23,24). In 2004, the onset of acne nodularis was reported in healthcare workers who wore N95 masks during the severe acute respiratory syndrome coronavirus (SARS – COV) outbreak in Singapore and designated as N95 acne (23). During the COVID-19 pandemic, protective masks became obligatory not only in healthcare professionals but also in the general population. Therefore, a greater number of individuals who suffered from acne associated with the prolonged wearing of protective masks have been referred to dermatologists, leading to the introduction of a new term for this variant of acne mechanica – "maskne" (13).

Maskne can present *de novo* and as an exacerbation of acne in patients with acne-prone skin. The recommended clinical criteria for maskne include the onset of acne within six weeks of regular face mask wear or exacerbation of acne over the masked area, distribution of lesions in so-called "O-zone", and exclusion of differential diagnoses such as perioral dermatitis, seborrheic dermatitis, *Malassezia* folliculitis and rosacea (13).

The pathophysiological process in maskne can be explained by several mechanisms: thickening of the epidermis, follicular occlusion, increased sebum secretion, decreased skin resistance to shear forces, and skin microbiome dysbiosis (17,19, 25-29).

Masks cause mechanical stress (pressure, friction, and rubbing) to the skin, leading to keratinocyte proliferation and subsequent hyperkeratosis characterized by the alteration of the stratum corneum, reduced water content, irritation, and a disrupted skin barrier (19). Furthermore, mask-induced pressure may stimulate the occlusion of the pilosebaceous

duct (25). In addition, both pressure and friction may cause mechanical rupture of comedones and subsequent inflammation (26).

The increased temperature inside the mask due to the occlusion leads to skin hyperhydration, which decreases skin resistance to shear forces from rubbing. The skin susceptibility to shear forces may be additionally worsened due to sweating (17). Moreover, the raised temperature under the mask increases sebum secretion and causes qualitative changes in surface lipids (increased squalene portion) (27). In addition, increased humidity and sweating may promote swelling of keratinocytes, thereby inducing follicular occlusion (28).

Skin microbiome dysbiosis is caused by mechanical factors and the alteration of skin pH, temperature, and humidity under the mask (19). The changes in skin microbiome mainly comprise over-colonization of virulent strains of *C. acnes* (29). In addition, the changes in *Staphylococcus epidermidis* (*S. epidermidis*) colonization may be implicated. Namely, some studies found increased colonization of *S. epidermidis* in patients with acne, whereas other showed that *S. epidermidis* might inhibit the growth of several pathogenic bacteria (30). Skin dysbiosis activates innate immunity, primarily via the activation of toll-like receptors (TLRs) and proteinase-activated receptors (PARs), leading to the production of pro-inflammatory cytokines (IL-1, Il-6, IL-8, TNF-α) and the affluence of neutrophils and T-lymphocytes (19).

The prevalence of acne due to prolonged mask-wearing has been reported to be between 1.3% and 53.1% (24,31-41) (Table 1). This wide range of maskne prevalence may be due to various factors such as the participants' profession, the sample size, genetics, environmental factors, mask-wearing duration, the type of mask, and previous facial skin disease. It has been shown that long hours of mask-wearing (more than 4 hours/day) and unsuitable mask size increase the risk for maskne (26,34). Regarding the association of maskne with the particular type of masks, Chaiyabutr *et al.* found a higher incidence of maskne in patients who wore surgical masks than in those who used fabric masks. The same study showed a lower

Table 1. Studies reporting the prevalence of acne among persons who wore protective masks during a prolonged period

Authors	Country	Year	Number of participants	Occupation of participants (HCW/non-HCW)	Type of masks	Acne prevalence N (%)
Foo CC *et al.* (24)	Singapore	2006	322	HCW	N95 respirators	65 (20.20%)
Zuo Y *et al.* (31)	China	2020	404	HCW	N95 respirators	44 (10.90%)
Singh M *et al.* (32)	India	2020	43	HCW[a]	N95 respirators	5 (11.60%)
Choi SY *et al.* (33)	Korea	2020	330	HCW and non- HCW	N95/KF94/KF 80 respirators; surgical/dental masks; cotton masks	112[b] (33.94%)
Techasatian L *et al.* (34)	Thailand	2020	833	HCW and non- HCW	Cloth masks; surgical masks; surgical masks with cloth covering; N95 respirators	333 (39.90%)
Metin N et al. (35)	Turkey	2020	526	HCW and non- HCW	NS	20 (39.40%)
Daye M et al. (36)	Turkey	2020	440	HCW[a]	Surgical masks; N95-N99 respirators	44 (10.00%)
Hadjieconomou S *et al.* (37)	United Kingdom	2020	72	HCW	NS	1 (1.30%)
Ferguson RJ *et al.* (38)	United Kingdom	2021	231	HCW	Different kinds of masks, including FFP3 respirators and reusable masks (other NS)	26 (11.26%)
O'Neill H *et al.* (39)	United Kingdom and Ireland	2021	337	HCW	Surgical masks; respirators	45 (13.35%)
Chaiyabutr C *et al.* (40)	Thailand	2020	1231	Non- HCW	Fabric masks; surgical masks; N95 respirators	396 (32.20%)
Rosner E (41)	USA	2020	343	HCW	N95 respirators; surgical masks	182 (53.10%)

HCW: healthcare workers; N: number; non-HCW (non-healthcare workers); NS: not specified

[a] HCW including paramedical staff who were indirectly involved in managing patients of COVID-19.

[b] Including the onset of acne and aggravation of acne.

incidence of maskne associated with N95 respirator usage when compared with surgical and fabric masks, respectively. The latter results were explained by the fact that this study included non-healthcare workers, who might not adjust their N95 masks properly to fit tightly against their faces (40). The higher incidence of maskne related to N95 respirators in other studies, including medical personnel, favors this explanation (24,42).

MASKNE TREATMENT: PREVENTION IS BETTER THAN THE CURE

The primary preventive measure for maskne is face washing in the morning and at the end of the day, using mild, non-soap cleansers that maintain the skin barrier (43). In addition, the skin microbiome should be preserved using non-comedogenic moisturizers, preferably as cream, lotion, serum, or mist, whereas ointments should be avoided (25,43). Moisturizers should be used at least 1 hour before using a mask. Furthermore, long periods of continuous mask-wearing should be avoided; hence, it is recommended to take "mask breaks" for 15 minutes every two hours, if possible (43).

Treatment of maskne depends on the severity of the disease. In mild cases, topical therapy should achieve satisfactory results, whereas systemic therapy may be needed in moderate and severe cases. Skin cleansing twice daily, using a mild, non-comedogenic, pH-balanced cleanser, is essential for topical treatment (25). When prescribing topical therapy, it should be taken into account that some substances, such as salicylic acid, benzoyl peroxide, retinoids, and alpha-hydroxy acids, may induce irritative contact dermatitis, leading to the worsening of acne (25,29). However, topical retinoids, with or without benzoyl peroxide, are recommended in most patients with comedonal and/or papulopustular acne (14). In those cases, adapalene is preferred over tretinoin due to its better tolerability profile, and the frequency of its use may vary from once or twice a week to every day. In cases of maskne combined with postinflammatory hyperpigmentation, azelaic acid 15% gel or foam should be recommended (25). To avoid irritation, topical retinoids and other prescription topical treatments should be applied in the evening, whereas non-comedogenic moisturizers should be applied in the morning at least one hour before wearing the mask. Adequate moisturizers may calm possible irritation from the prescription treatment and help maintain the skin microbiome balance. In moderate to severe maskne, oral antibiotics, such as doxycycline 100-200 mg daily up to 12 weeks, should be added (14,25).

CONCLUSION

Maskne has been recognized as a common skin disorder in the era of the COVID-19 pandemic. Given that the use of masks in public tends to become the "new normal" even in the post-pandemic period, the issue of maskne could become even more significant. However, adequate skin care may prevent or at least allay maskne in the majority of persons.

References:

1. Morens DM, Daszak P, Taubenberger JK. 2020. Escaping Pandora's box – another novel coronavirus. N Engl J Med. 2020;382:1293-5.
2. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 – 11 March 2020. Available at: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 Last accessed: 9th August 2021.
3. World Health Organization. WHO coronavirus (COVID-19) dashboard. Available at: https://covid19.who.int. Last accessed: 2nd July 2021.
4. Singhal T. A Review of Coronavirus Disease-2019 (COVID-19). Indian J Pediatr. 2020;87:281-6.
5. Triggle CR, Bansal D, Farag EABA, Ding H, Sultan AA. COVID-19: Learning from lessons to guide treatment and prevention interventions. mSphere. 2020;5:e00317-20.
6. Guo ZD, Wang ZY, Zhang SF, Li X, Li L, Li C, *et al.* Aerosol and surface distribution of severe acute respiratory syndrome coronavirus 2 in hospital wards, Wuhan, China, 2020. Emerg Infect Dis. 2020;26:1583-91.
7. Su Z, Wen J, McDonnell D, Goh E, Li X, Šegalo S, *et al.* Vaccines are not yet a silver bullet: The imperative of continued communication about the importance of COVID-19 safety measures. Brain Behav Immun Health. 2021;12:100204.
8. Howard BE. High-Risk Aerosol-Generating Procedures in COVID-19: Respiratory Protective Equipment Considerations. Otolaryngol Head Neck Surg. 2020;163:98-103.
9. Hrvatski zavod za javno zdravstvo. Klasifikacije i označavanje razine filtriranja kirurških i zaštitnih maski (HZJZ). Avalible at: https://www.hzjz.hr/sluzba-epidemiologija-zarazne-bolesti/klasifikacije-i-oznacavanje-razine-filtriranja-kirurskih-i-zastitnih-maski/. Last accessed: 16th May 2021.
10. World Health Organization. Masks use in the context of COVID-19: Interim Guidance. Available at:

https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak. Last accessed: 16th May 2021.

11. Daoud AK, Hall JK, Petrick H, Strong A, Piggott C. The potential for cloth masks to protect health care clinicians from SARS-CoV-2: A rapid review. Ann Fam Med. 2021;19:55-62.
12. İnan Doğan E, Kaya F. Dermatological findings in patients admitting to dermatology clinic after using face masks during Covid-19 pandemia: A new health problem. Dermatol Ther. 2021;34:e14934.
13. Teo WL. Diagnostic and management considerations for 'Maskne' in the era of COVID-19. J Am Acad Dermatol. 2021;84:520-1.
14. Nast A, Dréno B, Bettoli V, Bukvic Mokos Z, Degitz K, Dressler C, *et al.* European evidence-based (S3) guideline for the treatment of acne - update 2016 - short version. J Eur Acad Dermatol Venereol. 2016;30:1261-8.
15. Gollnick HP. From new findings in acne pathogenesis to new approaches to treatment. J Eur Acad Dermatol Venereol. 2015;29(Suppl 5):1-7.
16. Beylot C, Auffret N, Poli F, Claudel JP, Leccia MT, Del Giudice P, *et al.* Propionibacterium acnes: an update on its role in the pathogenesis of acne. J Eur Acad Dermatol Venereol. 2014;28:271-8.
17. Draelos ZD. Acne mechanica. In: Zeichner JA, ed. Acneiform Eruptions in Dermatology: a Differential Diagnosis. New York: Springer; 2014. pp.125-8.
18. Mills OH Jr, Kligman A. Acne mechanica. Arch Dermatol. 1975;111:481-3.
19. Dreno B, Bettoli V, Perez M, Bouloc A, Ochsendorf F. Cutaneous lesions caused by mechanical injury. Eur J Dermatol. 2015;25:114-21.
20. Levine N. Dermatologic aspects of sports medicine. J Am Acad Dermatol. 1980;3:415-24.
21. Moreno JC, Gata IM, Garcia-Bravo B, Camacho FM. Fiddler's neck. Am J Contact Dermat. 1997;8:39-42.
22. Dahl MG. Flautist's chin: a companion to fiddler's neck. Br Med J. 1978;2:1023.
23. Tan TK, Malcom W N95 Acne. International Journal of Dermatology, 2004;43:522-3.
24. Foo CC, Goon AT, Leow YH, Goh CL. Adverse skin reactions to personal protective equipment against severe acute respiratory syndrome--a descriptive study in Singapore. Contact Dermatitis. 2006;55:291-4.
25. Aguilera SB, De La Pena I, Viera M, Baum B, Morrison BW, Amar O, *et al.* The impact of COVID-19 on the faces of frontline healthcare workers. J Drugs Dermatol. 2020 Sep 1;19:858-64.
26. Damiani G, Gironi LC, Grada A, Kridin K, Finelli R, Buja A, *et al.* COVID-19 related masks increase severity of both acne (maskne) and rosacea (mask rosacea): Multi-center, real-life, telemedical, and observational prospective study. Dermatol Ther. 2021;34:e14848.
27. Narang I, Sardana K, Bajpai R, Garg VK. Seasonal aggravation of acne in summers and the effect of temperature and humidity in a study in a tropical setting. J Cosmet Dermatol. 2019;18:1098-4.
28. Sardana K, Sharma RC, Sarkar R. Seasonal variation in acne vulgaris - myth or reality. J Dermatol. 2002;29:484-8.
29. Teo WL. The "Maskne" microbiome - pathophysiology and therapeutics. Int J Dermatol. 2021;60:799-809.
30. Lee YB, Byun EJ, Kim HS. Potential Role of the Microbiome in Acne: A Comprehensive Review. J Clin Med. 2019;8:987.
31. Zuo Y, Hua W, Luo Y, Li L. Skin reactions of N95 masks and medial masks among healthcare personnel: A self-report questionnaire survey in China. Contact Dermatitis. 2020;83:145-7.
32. Singh M, Pawar M, Bothra A, Maheshwari A, Dubey V, Tiwari A, *et al.* Personal protective equipment induced facial dermatoses in healthcare workers managing Coronavirus disease 2019. J Eur Acad Dermatol Venereol. 2020;34:e378-e380.
33. Choi SY, Hong JY, Kim HJ, Lee GY, Hyun CS, Jung HJ, *et al.* Mask induced dermatoses during COVID-19 pandemic: A questionnaire-based study in 12 hospitals of Korea. Clin Exp Dermatol. 2021 Dec;46:1504-10.
34. Techasatian L, Lebsing S, Uppala R, Thaowandee W, Chaiyarit J, Supakunpinyo C, *et al.* The effects of the face mask on the skin underneath: A prospective survey during the COVID-19 pandemic. J Prim Care Community Health. 2020;11:2150132720966167.
35. Metin N, Turan Ç, Utlu Z. Changes in dermatological complaints among healthcare professionals during the COVID-19 outbreak in Turkey. Acta Dermatovenerol Alp Pannonica Adriat. 2020;29:115-22.
36. Daye M, Cihan FG, Durduran Y. Evaluation of skin problems and dermatology life quality index in health care workers who use personal protection measures during COVID-19 pandemic. Dermatol Ther. 2020;33:e14346.

37. Hadjieconomou S, Hughes J, Kamath S. Occupational skin disease during the COVID-19 pandemic, as captured in a Dermatology staff clinic in the United Kingdom. J Eur Acad Dermatol Venereol. 2020;34:e670-e671.

38. Ferguson FJ, Street G, Cunningham L, White IR, McFadden JP, Williams J. Occupational dermatology in the time of the COVID-19 pandemic: a report of experience from London and Manchester, UK. Br J Dermatol. 2021 Jan;184:180-2.

39. O'Neill H, Narang I, Buckley DA, Phillips TA, Bertram CG, Bleiker TO, *et al.* Occupational dermatoses during the COVID-19 pandemic: a multicentre audit in the UK and Ireland. Br J Dermatol. 2021 Mar;184:575-7.

40. Chaiyabutr C, Sukakul T, Pruksaeakanan C, Thumrongtharadol J, Boonchai W. Adverse skin reactions following different types of mask usage during the COVID-19 pandemic. J Eur Acad Dermatol Venereol. 2021;35:e176-e178.

41. Rosner E. Adverse Effects of Prolonged Mask Use among Healthcare Professionals during COVID-19. J Infect Dis Epidemiol. 2020;6:130.

42. Lan J, Bs ZS, Miao X, Li H, Li Y, Dong L, *et al.* Skin damage among health care workers managing coronavirus disease-2019. J Am Acad Dermatol. 2019;82:1215-6.

43. Desai SR, Kovarik C, Brod B, James W, Fitzgerald ME, Preston A, *et al.* COVID-19 and personal protective equipment: Treatment and prevention of skin conditions related to the occupational use of personal protective equipment. J Am Acad Dermatol. 2020;83:675-7.