

Maskne in Covid-19 Pandemic: A Review

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ABSTRACT

Background: *Maskne* is a contraction of mask related acne and describes a form of acne in the O-area secondary to the prolonged use of facial masks. Existing literature about *maskne* during the pandemic is limited but current theories for the pathophysiology underlying *maskne* development include a combination of mechanical stress and imbalance of the skin microbiome. The aim of this review was to assess risk factors for developing *maskne*.

Method: This review conducted a comprehensive search of scientific publications using the keywords “acne vulgaris”, “*maskne*”, and “Covid-19” in ProQuest and PubMed database spanned from 2021 to 2022. Inclusion criteria were different studies such as original research articles, experimental and observational research regarding *maskne* during Covid-19 pandemic. Publications such as systematic or literature review and those which weren't in English language were excluded from this review.

Result: The database search yielded 14 reports that included outcomes of interest in risk factors of *maskne* during Covid-19 pandemic. The risk factors for developing *maskne* are increased in 1) Healthcare workers especially those who wear masks for longer than 5-8 hours/day; 2) High temperature and humidity; 3) People who wear N95 instead of surgical or cloth mask; 4) People with history of pre-existing acne; 5) Teenager and female population; and 6) Those who were treated with retinoids, topical benzoyl peroxide or salicylic acid.

Conclusion: Further studies on mask-related acne are still needed to better understand the pathophysiologic mechanism of *maskne*.

Keywords: *Maskne*, Mask related acne, Covid-19 pandemic

INTRODUCTION

Coronavirus disease 2019 (COVID-19) has spread worldwide since it was first discovered in December 2019, and the pandemic continues to this day. The main disease transmission route is by droplets of an infected person. To reduce the risk of infection, people have to modify their daily routine, introducing new habits and devices. Personal protective equipment (PPE), such as face masks, can help prevent infection. [1,2]

A face mask is a piece of covering that generally aims to cover the oral and nasal apertures, while being hooked onto the ears. Three types of face mask that are most commonly used: cloth masks, surgical masks and N-95 respirators. Their use, first only among healthcare workers and then among general population, has led to an increase of facial dermatoses, i.e., acne, rosacea, seborrheic dermatitis, and contact dermatitis. This phenomenon was so prevalent that a new description term, *maskne*, has been coined. [3]

Acne is a chronic inflammatory disease of the pilosebaceous unit. It is the eighth most common disease worldwide, with a prevalence rate of 9.4%. It affects 85% of people between the ages of 12 and 24, as well as 8% of adults aged 25 to 34 years old and 3% of adults aged 35 to 44 years old. [4]

Maskne is a contraction of mask related acne and describes a form of acne in the O-area secondary to the prolonged use of facial masks. Although effective prevalence is unknown, there is currently an increasing request for consultations due to acne onset or its worsening. [5]

Clinical criteria proposed for *maskne*: onset of acne within 6 weeks of start of regular face

mask wear or exacerbation of acne over the masked area, distinct pattern, referred to as the O-zone in this report and exclusion of differential diagnoses, including perioral dermatitis, seborrheic dermatitis, pityrosporum folliculitis, and acne rosacea. [6]

However, existing literature about maskne during the pandemic is limited. Current theories for the pathophysiology underlying maskne development include a combination of mechanical stress and imbalance of the skin microbiome. Occlusion of the skin with masks can lead to dysbiosis of the skin flora, retention of bio-fluids, and increased skin temperatures associated with heat and sweat-related dermatoses. Friction from masks also can lead to acne mechanica and frictional dermatitis and exacerbate existing inflammatory skin conditions. Furthermore, the usage of face mask has been shown to exacerbate preexisting acne in HCPs and the general population or induce new lesions in previously unaffected people. Although the COVID-19 infection does not present with acne or acneiform lesions, it may involve people with preexisting acne receiving systemic therapies, who may be concerned regarding the interaction between their treatment and the infection. [7,8] The aim of this systematic review was to assess risk factors for developing maskne.

MATERIALS & METHODS

This review conducted a comprehensive search of scientific publications using the keywords “acne vulgaris”, “maskne”, and “Covid-19” in ProQuest and PubMed database spanned from 2021 to 2022. Inclusion criteria were different studies such as original research articles, experimental and observational research regarding maskne during Covid-19 pandemic. Publications such as systematic or literature review and those which weren’t in English language were excluded from this review.

RESULT

After searching the database and removing duplicate articles, there were 41 studies found for screening purposes. Later, the title and abstract of these studies were screened through. The database screening yielded 14 reports that included outcomes of interest in maskne prevalence during Covid-19 pandemic. Out of 14 studies, 12 were retrospective studies, and the rest were 1 cohort and 1 prospective study. Most of the studies were reported in India (2) and Turkey (2), followed by one each from Romania, Nigeria, Pakistan, Italy, Korea, Poland, Saudia Arabia, Bangladesh, Germany, and Ghana. The studies’ participants consist of healthcare workers and non-healthcare workers.

Table 1. Details of maskne during Covid-19 pandemic

No	Author/ Country/ Year	Method	Participants	Key Findings
1	Cretu S, Dascalu M, Salavastru CM/ Romania/ 2022	Cross-sectional survey	134 health care providers, most participants were women (86.6%; n = 116), and most were doctors (79.9%; n = 107).	<ul style="list-style-type: none"> 50% reported current acne lesions and 56.7% required treatment. Of the latter, 65.8% self-medicated and 34.2% sought medical advice. The most common treatment associations between anti-acne topical products were: retinoids and salicylic acid (18.18%; n = 8), retinoids and benzoyl peroxide (13.64%; n = 6), salicylic acid and benzoyl peroxide (13.64%; n = 6), and azelaic acid together with salicylic acid (9.09%; n = 4). [8]
2	Falodun O, et al/ Nigeria/ 2022	Observational cross-sectional study	1316 persons participated in this study with mean age 34.4 ±12.3 years and median age 35.5 years. Male: female ratio was 1:1.41.	<ul style="list-style-type: none"> New onset acne or worsening of acne following consistent wearing of face masks was reported by 323 (24.5%) of the participants. The surgical face mask was the least likely to predispose to acne (p<0.05), while N95 face mask and cloth mask were 1.89 and 1.41 times more likely to have acne respectively.

				<ul style="list-style-type: none"> • Persons with prior history of acne were more likely to develop new acne or experience worsening of acne following wearing of face mask OR 3.89, 95% CI 2.85, 5.33; (p<0.05). • The length of time of daily mask wearing was not significantly associated with occurrence of new onset acne or worsening of acne. • Persons reporting prior histories of allergy were more likely to develop acne. [9]
3	Yaqoob S, et al/ Pakistan/ 2021	Cross-sectional	193 healthcare workers (HCW)	<ul style="list-style-type: none"> • Acne was prevalent in 103 (53.4%) participants with maximum cases reported in female HCWs, and in doctors (p<0.05). • Out of 73 HCWs using N-95 masks, 46 (44.7%) developed acne, with a p-value of 0.036. • Skin type and past history of acne also yielded statistically significant results. • HCWs with oily skin (64, 62.1%) were prone to face resurgence of acne or new-onset acne. • The most common sites of eruption of acne were along the cheeks (45.1%), followed by the nose (40.9%). • Majority of the population suffered from mild acne. Moderate and severe acne eruption was particularly observed in those wearing N-95 and surgical masks. [3]
4	Damiani G, et al/ Italy/ 2021	Multi-center, real-life, observational prospective study	A total 66 patients, 30 (median age: 34.0 [30.25-29.75] years) with acne and 36 patients (median age: 48 [43-54] years) with rosacea	<ul style="list-style-type: none"> • Patients with acne displayed an increased Global Acne Grading Scale (GAGS) score in mask-related areas (p<0.0001). • Remarkably, patients reported also a statistically significant decrease in their quality of life (p<0.0001). [10]
5	Park S, et al/ Korea/ 2022	Cohort	18 healthy adults (8 men; 10 women) who were asked to wear masks in their daily lives from June 2020 to June 2021.	<ul style="list-style-type: none"> • Trans-epidermal water loss, skin keratin amount, skin pore area, skin color, and skin elasticity changed significantly during the year. • Trans-epidermal water loss, skin hydration, skin keratin amount, skin pore area, and skin color were significantly different between the mask-wearing and non-mask-wearing areas of the face. [1]
6	Dash G, et al/ India/ 2022	Cross-sectional (web-based study)	A total of 178 participants completed the survey.	<ul style="list-style-type: none"> • The most common complaint was increased sweating (55.6%) followed by acne (34.3%) and oily skin (34.3%). • Significant association was found between skin changes and duration (>6h/day) of mask use, increasing number, and type of mask (N95) used (p value <0.05). [11]
7	Bansal H, Mittal R, Kumar V/ India/ 2022	Cross-sectional	30 patients with a diagnosis of irritant contact dermatitis aka maskne and 30 patients with diagnosis of acne vulgaris, all >18 years of age from April 2020 to December 2021	<ul style="list-style-type: none"> • 66% of people wore masks coming to hospital in the month of June 2020 (first wave) which increased to 74% during the second wave in the month of April 2021 and during the third wave only 23% of people wore masks in the month of December 2021. • 80% of the patients with maskne (24/30 patients) were those who used disposable face masks repeatedly and at least 4 hours a day.

				<ul style="list-style-type: none"> • 66.66% (20/30) of patients with acne vulgaris experienced their condition worsening due to using the same disposable mask repeatedly. • Compliance towards wearing a mask was seen to be lowest in people falling in the age group of 18–35 (18%), 24% in the age group of 56–75 years and was the highest among the age group of 36–55 years (58%).^[12]
8	Malczynska IU, Krych G, Baran Ana/ Poland/ 2022	Cross-sectional	Original survey was carried out among 300 non healthcare workers (N-HCW) and 60 healthcare workers (HCW) with 60 questions about using PPE and skin lesions experienced before and during the pandemic.	<ul style="list-style-type: none"> • The N-HCW group included 74% females and 26% males with an average age 24.67 ± 0.74. • The HCW group included 91.7% females and 8.3% males, with an average age of 30.07 ± 0.36. • All participants used PPE; N-HCW mainly chose a disposable (53.3%) and reusable masks (37.3%), while HCW preferred surgical (66.7%) and FFP2/FFP3/N95 masks (30%) and almost never used reusable masks (3.3%). • HCW mainly spent 5–8 h with PPE, and N-HCW spent 1–4 h with PPE/day. • HCW experienced more severe facial skin lesions than N-HCW (p<0.0001). There was statistical significance in following the basic hygienic rules of wearing PPE between both groups, where HCW practiced them more.^[13]
9	Bakhsh RA, et al/ Saudi Arabia/ 2022	Cross-sectional (A self-administered electronic survey was distributed to residents of Jeddah city using multiple social media platforms)	630 participants were enrolled, 470 (74.6%) were females and 160 (25.4%) were males, and the predominant age group was 18-30 years old, 374 (59.4%).	<ul style="list-style-type: none"> • The majority of participants wore a mask for five to seven days per week, 272 (43.2%), and for less than four hours per day, 378 (60%). • The surgical masks were the most frequently used masks, with 597 (94.8%). • 379 (60.2%) participants had no previous skin disease on their faces. Only 251 (39.8%) of the participants had preexisting skin diseases affecting the face. Of those, acne was the most frequent skin condition, 217 (86.4%), followed by atopic dermatitis, 12 (4.8%). • 97 (23.5%) participants without a prior history of acne reported the new onset of acne during the pandemic with the use of a face mask or face shield. 30 people (59.9%) who had acne on their faces before the pandemic said that their acne got worse when they wore face masks or face shields for a long time.^[4]
10	Roy S, et al/ Bangladesh/ 2022	Cross-sectional	1297 people were approached using a fixed-step procedure on a random route sample where 803 fulfilled the inclusion criteria	<ul style="list-style-type: none"> • The overall prevalence of dermatological manifestation in this study was 40.85%. The common dermatological manifestations due to facemasks use were acne (26%), allergy symptoms (24%), traumatic symptoms (24%), and other symptoms (26%). Two important frequently reported risk factors were previous history of skin diseases and obesity. • Females were more likely to have acne (CI: 1.199, 3.098; p = .007) and allergy issues (CI: 1.042, 2.359; p = .031). • N95 and KN95 masks were more likely to produce allergic symptoms, while surgical mask users were more likely to develop acne.

				<ul style="list-style-type: none"> Acne was prevalent more than twice (CI: 1.42, 4.26; $p = 0.001$) in persons with a COVID-19 infection history. ^[14]
11	Dani A, Eseonu A, Bibee K/ Germany/ 2022	Cross-sectional	227 medical students, resident physicians, and nursing students at Johns Hopkins Medicine,	<ul style="list-style-type: none"> 68.7% of participants reporting development of maskne. Surgical masks and respirators were the most prevalent mask types worn at work. Gender ($p = 0.003$) and duration of mask use ($p = 0.048$) are significant risk factors for maskne development. ^[6]
12	Kurt BO/ Turkey/ 2021	Cross-sectional	A total of 172 physicians (female, $n = 159$, male; $n = 13$, mean age = 35.03 ± 5.27 years) who had acne in any period of their life	<ul style="list-style-type: none"> 45.35% of the participants reported that their acne complaints increased, 27.33% reported relapses, and 7.56% reported occurrence for the first time. Newly formed acne was reported most frequently on the chin (78.26%). The number of female participants, smoking, increased stress, and the rate of surgical mask use were found to be higher in the group whose acne occurred for the first time, relapsed, or increased than in the group whose acne complaints were unchanged or decreased ($p < 0.05$). In the group whose acne relapsed or increased, adult-onset acne, presence of scar, and use of systemic acne treatment before the COVID-19 pandemic were more common than in the group whose acne complaints were unchanged or decreased ($p < 0.05$). ^[15]
13	Vural AT/ Turkey/ 2022	Cross-sectional	A face-to-face survey was conducted to 200 participants (84 males, 116 females) who composed of third- and fifth-grade medical faculty students.	<ul style="list-style-type: none"> The mean age of the participants was 21.39 ± 1.34 (range, 19–26 years). 40.5% of the students developed new AV, 20.5% had exacerbation of their old AV. Lesions developed most frequently in the cheek (51%) and chin (45.5%) regions. During the COVID-19 pandemic, being female ($p = 0.04$), prolonged masks use ($p = 0.001$), and fewer mask changes throughout the day ($p = 0.01$) were found to be associated with the development of AV. ^[16]
14	Gyapong F, Debrah E, Oforiwa M, Isawumi A, Mosi L/ Ghana/ 2022	Cross-sectional	Google Forms online questionnaire. The survey targeted regular and occasional face mask users around the world.	<ul style="list-style-type: none"> Almost 60% (1243) of the 2136 participants indicated discomfort while using face masks. Breathing difficulties and pain around the ears were cited as major causes of discomfort, accounting for 32% and 22%, respectively, of responses. Headaches were reported by 26.8% (572) of the respondents, with 44.6% experiencing one within 1h of wearing a mask. 908 respondents experienced nasal discomfort, while 412 individuals reported various skin-related discomfort, including excessive sweating around the mouth and acne. ^[17]

DISCUSSION

Based on the findings, it can be stated that there are several factors contributing to prevalence of maskne during Covid-19 pandemic.

1. Occupation

Acne is a widely prevalent inflammatory skin disease, in which the pilosebaceous units play an important role. Sebum accumulation, obstruction of the units, and *Cutibacterium acnes* proliferation all participate in the pathophysiology of acne. The frequent use of face masks during the day for long periods

could increase humidity and sebum production in the sebaceous glands and its concentration on the surface of the skin, prompting acne lesions or aggravating an existing condition. [18]

According to Raju, et al, various studies indicated a higher incidence of mask acne in healthcare workers compared to the general public, which can be explained by the increased hours of wearing personal protective equipment. In a study by Foo et al, all patients who developed acne reported using N95 respirators for an average duration of eight hours per day for a mean period of 8.4 months. Lan et al described higher incidence of acne in HCP's who wore masks for longer than six hours. Techasatian et al showed that wearing masks up to four hours per day increased the risk for acne. The risk of acne was increased by 1.5 times in people who changed their masks every 2 to 3 days, compared to the people who changed masks on a daily basis. [19]

Malczynska et al found that healthcare workers (HCW) mainly spent 5–8 h with PPE, and non-healthcare workers (N-HCW) spent 1–4 h with PPE/day. HCW experienced more severe facial skin lesions than N-HCW ($p < 0.0001$). [13] In a single variable analysis study by Dani, et al, longer duration of mask use and gender are significant risk factors for maskne development. As these factors are non-modifiable, targets for intervention should be to improve maskne prevention education, regardless of acne history, given the continued COVID-19 infection burden in 2022. [6]

2. Temperature and Humidity

The exact pathobiology of mask-induced dermatitis remains relatively unexplored. However, frequent friction, trapping of sweat and elevation of temperature may be the causative factors. Hua et al showed that skin reaction to a mask is characterized by a compromised skin barrier function, as indicated by increased TEWL. Individuals with a history of atopic dermatitis, contact dermatitis and rosacea experienced compromised skin barrier function.

Therefore, these people were more susceptible to increased temperature, extreme moisture and friction induced by their masks. [20]

When people wear a face mask, the internal temperature and humidity in the mask tend to increase, leading to a substantial increase in the skin temperature of the mask-wearing area. In addition, the skin may be “blocked” and bodily fluids such as perspiration may remain on the skin. The high temperature of the mask microclimate could increase the skin surface temperature, lowering the inflammatory threshold and reducing skin resistance. High humidity around the skin increases the hydration of the stratum corneum. When the skin is overhydrated keratinocytes swell and change the skin structure, which can damage the skin barrier. In addition, when the sebaceous glands are compressed and blocked by face mask, the secretion of sebum may not occur well. This can increase the inflammatory response and change the pH of the skin. Park et al investigated how the skin was affected by microclimate changes around the skin caused by prolonged use of mask and they found that after participants started to wear a mask daily, the skin may have been naturally affected by aging and the external environment (seasonal changes). During this period, considering this, TEWL, an indicator of skin barrier damage, showed significant changes in the mask-skin zone, especially in the cheek. The cheek is affected by the mask microclimate; simultaneously, there is physical stimulation caused by the direct contact of the mask. [1]

Several studies have observed an increased skin temperature, moisture (from respiration), and decreased hydration mostly over the cheeks, perioral area, and chin due to prolonged usage of face masks (>6 h). As a result, there is increased sebum excretion in the mask wearing areas (sebum excretion rate is directly proportional to the rise in temperature/humidity). All these along with repeated friction and pressure of the mask being in constant contact with the skin for prolonged periods irritate the upper part of

the pilosebaceous duct, blocking it and resulting in mask acne. These factors also lead to the altered skin barrier.^[11] This is consistent with what Hua et al found in their study, that skin reactions to the face-mask are characterized by a compromised skin barrier function, as indicated by increased TEWL and pH. Measuring TEWL is a non-invasive method that allows for the evaluation of the skin barrier function. They determined that over-hydrated skin causes sweat and that areas with an increased amount of sweat resulted in a high TEWL. The normal acidic pH of the stratum corneum has an important role in the formation and maintenance of the permeability barrier and in antimicrobial defense. Skin pH was significantly more alkaline on masked areas, which is consistent with previous findings of changes on diapered skin.^[21]

Han et al and Spigariolo et al stated that higher temperature has a close correlation with the flare of acne, which can be explained by the effect of higher temperature on the sebum excretion rate. The sebum excretion rate varies directly when local temperature changes, and sebum excretion increases by 10% for each 1°C rise. Furthermore, squalene could become significantly more in surface lipid when temperature increases. The ambient high humidity precipitates acne is mainly due to poral occlusive effect of skin hydration and irritation to the upper parts of pilosebaceous duct. Moreover, the increase of humidity plays a role through the poral occlusive effect, irritation, and swelling of the skin. Both sweat and increased humidity may cause acute obstruction and aggravate acne. Moreover, changes in both surface sebum composition and skin hydration could contribute to disruption of skin barrier, leading to bacterial microflora imbalance.^[2, 22]

3. Type of Mask

Skin microbiota is influenced by genetic and external factors such as environment, pH, and temperature, all of which are modified with mask wearing and retention of biofluids.

A textile is defined as any material that is woven and these materials can be synthetic (i.e., plastic-derived) or natural fibers (i.e., cotton, linen, and silk). Traditionally, dermatologists have recommended cotton as the only comfortable tissue suitable for patients with dermatological conditions. With the advancement of materials engineering, synthetic fibers with improved functions of breathability and waterproofing, and the added properties of quick-dry, increased comfort (compared to cotton), surface modification with antimicrobial properties, have emerged as a complementary tool in dermatologic treatments. Chemical sunscreens can induce sensitization because of photodegradation, worse in individuals with atopy when in contact with sweat/moisture under occlusion. Water-resistant sunscreen with high lipophilic/ hydrophilic ratios increases comedogenicity. Ultraviolet protective (UPF) 50+ fabrics used for mask wear should be the principal intervention for broad-spectrum sun protection for the lower half of the face during the COVID-19 pandemic.^[7] Foo et al reported cases of acne to be associated with N95 respirators but not surgical or fabric masks during the SARS epidemic in 2003. This may be attributed to the greater air impermeability and increased local pressure of N95 masks. Also, masks with a nasal metal wire or xation bar have been associated with increased predisposition to acne and nickel contact sensitivity in wearers. Surgical masks covered by a cloth mask have also been associated with increased predisposition to acne. In general, medical masks have been linked to higher predisposition for acne, compared to cloth masks, although the type of fabric must be taken into consideration.^[23] While the N95 face mask is thought to be most protective against diseases transmitted via the airborne or droplet route, it appears the least protective against acne as found in our study and also reported in other studies. We postulate that this may result from inappropriate re-use of this mask. It is commonplace in low resource settings such

as ours to re-use these face masks many times—sometimes up to ten times. The sweating and inadvertent spread of skin microbiota to the mask may create good growth conditions for the microbes which subsequently recolonize the skin in greater numbers when the mask is worn subsequently.^[9]

The majority of healthcare workers had mild acne, which was frequently reported among cloth mask wearers. Those wearing surgical and N-95 masks, on the other hand, developed severe acne. Surgical masks are typically made of multiple layers of fabric with two filter sheets, which may account for the severity. Furthermore, the thickness of N-95 with metal wiring covering the nasal bridge makes it more compact and airtight, resulting in a humid environment for bacterial growth and thus increasing severity. Cloth masks, on the other hand, are made of various textile materials, such as cotton, and provide comfort to the wearer. This result could also be attributed to the fact that the number of cloth mask users in this study was lower than the other groups.^[3]

Hua et al evaluated cutaneous short-term changes in patients wearing SM and N95, finding that masks induce microenvironment changes in the skin by dehydration, increased sebum and increased PH. Furthermore, dehydration, transepidermal water loss, and sebum dysregulation are pro-comedogenic factors, capable to promote Cutibacterium acnes multiplication, and hence innate immune response and leading to inflammatory lesions (papules and pustules). Since mask wearing worldwide was maintained due to COVID-19 pandemics, we expect an increase in the prevalence of maskne and mask rosacea and establishing recommendations/ guidelines to support dermatologists and family doctors in the differential diagnosis and management is needed and should be based on big data.^[10]

The right mask can fit snugly but be not too tight, contain two or more layers, be made up of a soft fabric like cotton, and should contain a wire at the top to prevent leakage of air. Synthetic masks made of nylon or

rayon should be avoided as they can irritate the skin. In 2020, some scientists looked into the performance of face masks made of several common fabrics, including cotton, silk, chiffon, flannel, various synthetics, and combinations of these. They found that combining layers of different fabrics such as silk or chiffon and cotton improved the filtration rate, offering more protection from the virus. They suggested that combining two layers of silk with one of densely woven cotton, combined without gaps between layers, may be the best option for preventing the transmission of particles.^[12]

4. *History of Acne*

In a study by Daye et al more than 50 percent of health care workers using personal protective equipment in the form of masks, especially those with a metal nose bridge, reported an increase in pre-existing acne. In a study by Ramesh A et al, the incidence of mask induced acne among health care workers (doctors) was found to be 62.3 percent, among which 50 percent had new onset acne, whereas the other 50 percent had an aggravation of pre-existing acne. Other than masks, goggles and face shields were also implicated in causing acne.^[19]

Özkesici revealed that acne relapsed more or aggravated more in patients with acne scars, and the presence of scar increased threefold acne formation. In addition, the rate of not receiving treatment before the COVID-19 pandemic was higher in the group whose acne was unchanged or decreased, while the rate of receiving systemic treatment was higher in the group whose acne relapsed or increased. In the light of these findings, the severity of acne experienced before the COVID-19 pandemic may be considered to contribute to the development of acne during the COVID-19 pandemic. In addition, adult-onset acne and the presence of acne only in adulthood were found to be effective in terms of acne development during the COVID-19 pandemic. This study demonstrated the effect of previous personal acne history on newly formed acne in the COVID-19 pandemic. Stress is another factor that is considered to

affect acne. Many studies have reported an increase in acne severity with increasing stress.^{18–21} In this study, 97% of the participants reported that their stress increased during the COVID-19 pandemic in the group whose acne was triggered or increased, and this rate was statistically significantly higher than the group whose acne was unchanged or decreased.^[15]

5. *Age and Gender*

In a study by Zuo et al, underlying inflammatory facial dermatoses were found to be a significant risk factor for acne, which could be due to skin barrier pathology and alteration of skin microbiome. In another study, psychological stress and premenstrual are were found to be significantly associated with mask acne. Acne can be strongly associated with hormonal imbalance, which explains its high prevalence in the teenage population. States of hormonal dysregulation during other stages of life could also be related to triggering acne. Cortisol, for example, increases due to poor sleep, and stressful conditions could promote an inflammatory state possibly associated with an increase in acne lesions. Moreover, individuals that are experiencing greater sleep distress could present impaired sebum regulation caused by changes in testosterone levels.^[18]

Additionally, females had a significantly higher chance of reporting all kinds of skin irritation than males. A similar gender-specific finding was reported by Skiveren et al - the authors indicated that women in different age groups experienced more face mask-related skin itch than men.^[24] This study by Zuo Y et al describes mask-related adverse reactions in HCP. The higher prevalence of skin symptoms among women might be related to a lower threshold for reporting adverse reactions. The most frequent symptoms were pressure related.^[25]

6. *Treatments*

In healthcare providers with acne in prolonged medical face mask usage, the microenvironment, inclusively the local

microbiota, is altered. In addition, the skin barrier function may be compromised due to friction. This aspect may increase the irritant potential of classical anti-acne treatments such as topical retinoids or topical benzoyl peroxide. A study by Cretu et al stated that in their population, more than half of those who reported treatment used salicylic acid (61.36%) and the most common treatment association was with topical retinoids (18.18%). These treatment choices and associations have the potential to irritate the skin, particularly in cases with weakened skin barrier. These circumstances may accentuate itch, with unwanted consequences on the correct use of medical face masks.^[8]

Raju et al also concluded that conventional acne treatment, including retinoids, benzoyl peroxide, and salicylic acid, should be prescribed with caution, as they can lead to irritant contact dermatitis when followed by long hours of occlusion from masks. They should be applied during maskfree intervals. Cosmeceuticals containing plant extracts, essential oils, and phytochemicals with antiproliferative, anti-inflammatory and antimicrobial activity may be used for mask acne.^[19]

According to Han et al., patients suffering from *maskne* may benefit from the use of dermo-cosmetics for acne-prone skin. In *maskne*, antibiotics (AB) and fixed combinations of retinoids and AB, especially in hydrogel formulation, were more effective and safer than agents such as benzoyl peroxide (PB), salicylic acid, and retinoids alone due to the risk of irritation under the mechanical occlusion of masks.^[22]

Suggested general preventive measures include 1) daily changing of masks, in the case of surgical masks; 2) washing the mask after every use, in the case of cloth masks; 3) avoidance of occlusive substances like oil- or petrolatum-based emollients or cosmetic products; 4) use of a mild non-soap-based cleanser for the cleaning face; and 5) regular break times with removal of masks for 15 minutes every four hours in a socially distant space, such as outdoors or in one's own car. Specific therapeutic modalities include the

use of a mild retinoid at night (short contact period), either daily or on alternate nights as tolerated, especially in those with preexisting acne. Although retinoids can help prevent acne flares and might be preferred over benzoyl peroxide for this reason, they can also cause significant irritant dermatitis. This adverse effect is particularly pronounced when combined with the occlusive effect of a mask; therefore, care should be taken to avoid prolonged contact times and combination with other irritants such as salicylic acid or benzoyl peroxide, and the use of a noncomedogenic emollient prior to mask use should be encouraged. The use of oral antibiotics, topical antibiotics, and oral isotretinoin can be decided on a case-by-case basis. [26]

CONCLUSION

It can be concluded in this review that the risk factors for developing maskne are increased in 1) Healthcare personnels especially those who wear masks for longer than 5-8 hours/day, 2) High temperature and humidity; 3) People who wear N95 instead of surgical or cloth mask; 4) People with history of pre-existing acne; 5) Teenager and female population; and 6) Those who were treated with retinoids, topical benzoyl peroxide or salicylic acid.

Further studies on mask-related acne are still needed to better understand the pathophysiologic mechanism of maskne. It is also important to find an effective intervention to reduce the onset of maskne so there would be a guideline in treating mask-related acne.

Declaration by Authors

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