

# Factors aggravating acne vulgaris during the COVID-19 pandemic in China: a web-based cross-sectional survey

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**Abstract. – OBJECTIVE:** Acne vulgaris is a common skin disease worldwide. Throughout the COVID-19 pandemic, many patients with acne complained of worsening symptoms. This investigation was designed to survey the impact of COVID-19 regulations on acne and guide patients with acne on symptom management during the pandemic.

**MATERIALS AND METHODS:** From April 7<sup>th</sup> to April 21<sup>st</sup>, 2020, an anonymous, self-completed, web-based questionnaire was distributed to patients previously diagnosed with acne (via the Chinese internet medical software). Information collected included patients' mask-wearing routines and behavioral factors including dietary habits, sleep habits, facial hygiene, and make-up use habits.

**RESULTS:** 508 qualified questionnaire responses were collected. During the COVID-19 outbreak in China, there was an overall worsening of patients' acne symptoms (152, 29.9%). Behaviors including intake of sweets (34.9% vs. 16.0%,  $p < 0.01$ ), dairy consumption (32.9% vs. 23.3%,  $p < 0.05$ ), greasy (19.1% vs. 11.2%,  $p < 0.05$ ) and spicy food intake (30.3% vs. 14.3%,  $p < 0.01$ ) and mask-wearing frequency (>28 hours per week) (25.0% vs. 15.3%,  $p < 0.05$ ) presented a statistically significant difference between the acne aggravated and non-aggravated groups. Long-time mask-wearing (>28 hours per week), rather than the mask type, was significantly associated with acne symptom deterioration during the COVID-19 outbreak (odds ratio [OR]: 2.164; 95% confidence interval [CI]: 1.232-3.801).

**CONCLUSIONS:** Besides the well-known risk factors, such as sweets intake, dairy consump-

tion, and greasy and spicy food intake, wearing masks appears to trigger or aggravate acne during the COVID-19 pandemic. Limiting overall mask-wearing time may help to manage acne.

*Key Words:*

Acne vulgaris, COVID-19, Mask-wearing, Cross-sectional survey.

## Introduction

Acne vulgaris is a common, chronic inflammatory disease. Clinical features include seborrhea, inflammatory or non-inflammatory lesions, and various degrees of scarring. Acne is a devitalizing disease, causing both physical and mental suffering to the patient, with its long-term nature and tendency for recurrence or relapse. Though investigations on acne pathogenesis and mechanisms are still undergoing, many pathogenic factors have been identified within the modern lifestyle<sup>1</sup>. These factors include diet (sweets, dairy intake, greasy and spicy food), smoking, pressure, urban noise, socioeconomic pressures, light stimuli, and sleep<sup>2</sup>. These factors may cause abnormal synthesis and composition of sebaceous lipids in pilosebaceous units<sup>1</sup>, which may then impair the normal function of the sebaceous unit and cause worse acne symptoms.

In January 2020, a new coronavirus strain, COVID-19, was identified in China. This highly

contagious virus quickly spread worldwide, causing an international crisis. To contain the spread, the Chinese government implemented highly unprecedented control measures, including stay-at-home quarantine and mandatory masks in public.

Though these regulations were created to protect the public, they greatly influenced people's daily lives and altered their medical profiles. Indeed, many patients with acne in our hospital complained of worsening acne symptoms after the COVID-19 outbreak. Previous studies<sup>3</sup> surveying healthcare personnel have shown that frequent hand hygiene and personal protective equipment (PPE) can induce skin damage. Relevantly, other studies<sup>4,5</sup> have explored the relationship between facial masks and itchiness, atopic dermatitis, and other skin diseases. So far, there has been no direct, large sample research on the relationship between behavioral changes due to COVID-19 regulations and acne. With the government-issued COVID-19 control measures drastically modifying a patient's lifestyle and behavior, we hypothesized that the severity of patients with acne may be altered similarly.

The current study aimed at investigating the changes of disease severity and the possible influencing factors among patients with acne vulgaris during the COVID-19 pandemic in China.

## Materials and Methods

### Study Design

We conducted a cross-sectional study based on an online questionnaire through WeChat groups from April 7<sup>th</sup> to April 21<sup>st</sup>, 2020. Patients with acne participating in the study were first diagnosed in our hospital by at least two professional dermatologists in 2019. All participants were given a full explanation of the study and informed consent was obtained electronically *via* the Internet. Exclusion criteria included: (1) questionnaires with incomplete answers; (2) patients with systemic diseases and other facial diseases, such as rosacea, systemic lupus erythematosus, eczema, and seborrheic dermatitis; (3) patients with a long-term medication history (such as taking glucocorticoid during the survey). Finally, 508 patients with acne were included in the study. The study was conducted in accordance with the ethical standards of the Helsinki Declaration and was approved by the Institutional Review Board of Xiangya Hospital, Central South University (No. 202003026).

### Survey Questionnaires

The online questionnaire was anonymous. In total, 30 questions were set in questionnaire and the content mainly included the following aspects: the general demographic data (including sex, age, and other basic information), patient's behavioral changes through the first COVID-19 outbreak, and the severity of acne determined *via* a self-report global rating scale (Pillsbury grade) before and during the pandemic. The most important behavioral factors were the patient's mask-wearing routines, including frequency (hours per week) and type of mask worn. Other behavioral factors included dietary habits (including sweet, dairy, spice, and grease intake), sleep habits, facial hygiene, and make-up use. A one-grade or more change based on the measurement of Pillsbury grade was defined as worsening or improving of the acne symptoms.

### Statistical Analysis

The normal distribution data were statistically described by mean and standard deviation, and the differences were tested using Student's *t*-test. Non-normally distributed data were statistically described by median, and quartile spacing and compared between groups by non-parametric tests. Categorical variables were described proportionally, and differences were evaluated using Chi-square tests to find potential risk factors for the deterioration of acne. Logistic regression was used to estimate the correlation between acne and mask-wearing. The *p*-value lower than 0.05 was defined statistically significant and it was adjusted by the Bonferroni correction to decrease the risk of false positive results. An odds ratio (OR) was used to indicate the effect size, and the 95% confidence interval (CI) of OR was estimated. All the data was analyzed by SPSS Statistic v. 25 (IBM Corp., Armonk, NY, USA).

## Results

### Patients with Acne Involved and Their Reported Concerns and Appeals to Doctors

In total, 1,040 surveys were distributed, with 508 (48.8%) patients completing the questionnaire. The basic characteristics are shown in Table I; the average age was  $25.3 \pm 4.6$  years. 119 (23.4%) of the participants were male, and 389 (76.6%) were female. Before the COVID-19 pandemic, 54.1% had apparent blackheads, 77.8% had pap-

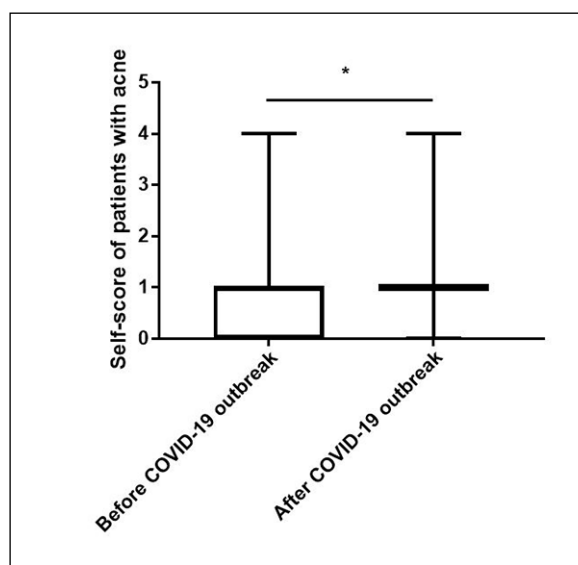
**Table 1.** Basic characteristics of the participants.

Characteristics	Total N = 508 (%)
Age (years), mean ± SD	25.3 ± 4.6
Sex, n (%)	
Men	119 (23.4)
Women	389 (76.6)
Symptoms before COVID-19	
Blackheads	275 (54.1)
Papulopustule	395 (77.8)
Acne marks and scars	340 (66.9)
Received treatment prior to COVID-19	
No	342 (67.3)
Yes	166 (32.7)
Symptom alterations after COVID-19	
Deterioration	152 (29.9)
Remission	93 (18.3)
No change	263 (51.8)
Self-score average	
Before COVID-19	1 (0.1)
After COVID-19	1 (1.1)
Mask wearing	
Yes	505 (99.4)
No	3 (0.6)

ules and pustules, and 66.9% had acne marks and scars. Before the COVID-19 outbreak, 67.3% of patients with acne received no treatment. During the COVID-19 pandemic, 152 (29.9%) participants experienced symptom aggravation (determined by at least a one-point increase on the Pillsbury scale). The average severity-score of the participants before the epidemic were  $0.94 \pm 0.84$  vs.  $1.02 \pm 0.82$  [1 (0.1) vs. 1 (1.1)] after the COVID-19 outbreak, and the difference was statistically significant (Figure 1). The most frequently reported symptom deteriorated was the enlarged areas of acne (71.88%), followed by an increased amount of scarring and pockmarks (41.25%).

We also evaluated the patients' concerns about acne during the COVID-19 pandemic (Figure 2) and found many patients with acne were worried about the acne symptoms getting worse due to mask-wearing (22.82%) or disrupted lifestyle behaviors (35.62%), such as dietary and sleep habits during the pandemic.

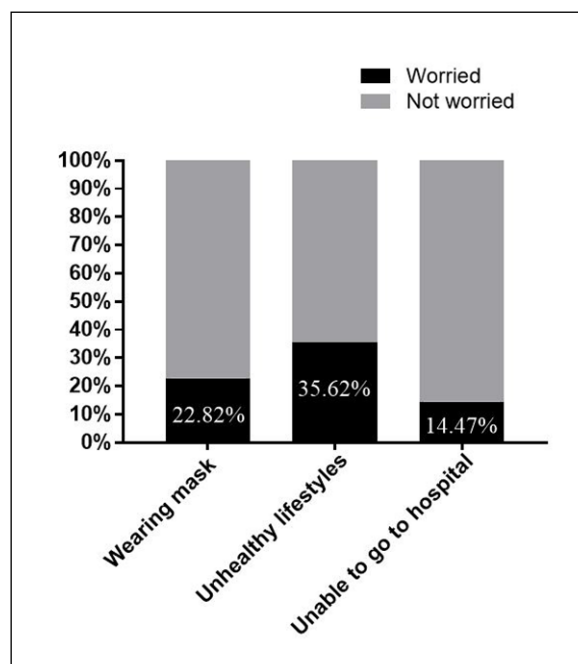
In addition, the results of our questionnaire showed that approximately 90% of patients reduced their visits to the doctor due to COVID-19. Instead, various non-face-to-face services were used to attempt to manage their symptoms during the pandemic, which included subscribing to skin-care services, acne-related health and hygiene education, online consultations, and tele-medicine services.



**Figure 1.** The self-score of patients with acne before and after first outbreak of COVID-19. (\* $p < 0.05$ ).

**Patients with Acne Reported Behavioral Changes During the First COVID-19 Outbreak**

The most frequent and significant behavioral change patients made was wearing masks (99.4%). Among them, the majority (62.8%) wore medical masks, 28.3% used disposable sur-



**Figure 2.** Patients' worries about risk factors of acne during first outbreak of COVID-19.

gical masks, and 6.9% used N95 or KN95 masks (**Supplementary Table I**). Over half (63.2%) of the patients reported occasional mask-wearing (<7 hours per week), while 18.1% reported frequent mask-wearing (>28 hours per week).

Other lifestyle changes including diets, circadian rhythms, and skincare habits throughout the COVID-19 pandemic were also evaluated in Table II. 21.7% of the patients reported an increased sweet food consumption, and 26.2% stated an increased dairy intake. Conversely, 63.0% reported reduced greasy food intake. 50.2% of them reported irregular sleep patterns throughout the first outbreak. Referring to facial hygiene habits, 37.8% of the patients reduced the time they spent cleaning their face, and 59.1% reduced their make-up use frequency.

**Behaviors Contributed to Acne Aggravation During COVID-19**

Differences in the lifestyles between the patients with or without acne deterioration during COVID-19 pandemic are shown in Table II. The result revealed that sweets intake (34.9% vs. 16.0%,  $p<0.01$ ), dairy consumption (32.9% vs. 23.3%,  $p<0.05$ ), greasy (19.1% vs. 11.2%,  $p<0.05$ ) and spicy food intake (30.3% vs. 14.3%,  $p<0.01$ ), and long-time mask-wearing (>28 hours per week) (25.0% vs. 15.3%,  $p<0.05$ ) were more common in those with acne deterioration than in those without. There were no statistically significant differences observed in the various sub-groups of circadian rhythms ( $p=0.289$ ), facial hygiene ( $p=0.149$ ), make-up habits ( $p=0.219$ ).

**Table II.** Proportion of acne deterioration among different lifestyles during the COVID-19 pandemic.

Related factors	Total n = 508 (%)	Deterioration n = 152 (%)	No deterioration n = 356 (%)	p-value
Sweets intake				<b>&lt; 0.01</b>
Increase	110 (21.7)	53 (34.9)	57 (16.0)	
Decrease	165 (32.5)	38 (25.0)	127 (35.7)	
No changes	233 (45.9)	61 (40.1)	172 (48.3)	
Dairy products intake				<b>0.02</b>
Increase	133 (26.2)	50 (32.9)	83 (23.3)	
Decrease	117 (23.0)	25 (16.4)	92 (25.8)	
No changes	258 (50.8)	77 (50.7)	181 (50.8)	
Greasy food intake				<b>0.014</b>
Increase	69 (13.6)	29 (19.1)	40 (11.2)	
Decrease	320 (63.0)	97 (63.8)	223 (62.6)	
No changes	119 (23.4)	26 (17.1)	93 (26.1)	
Spicy food intake				<b>&lt; 0.01</b>
Increase	97 (19.1)	46 (30.3)	51 (14.3)	
Decrease	105 (20.7)	28 (18.4)	77 (21.6)	
No changes	306 (60.2)	78 (51.3)	228 (64.1)	
Circadian rhythms				0.298
Regular	80 (15.7)	20 (13.2)	60 (16.9)	
Irregular	255 (50.2)	84 (55.3)	171 (48.0)	
No changes	173 (34.1)	48 (31.6)	125 (35.1)	
Facial hygiene				0.149
Increase	52 (10.2)	17 (11.2)	35 (9.8)	
Decrease	192 (37.8)	66 (43.4)	126 (35.6)	
No changes	264 (52.0)	69 (45.4)	195 (54.8)	
Makeup habits				0.219
Decrease	300 (59.1)	96 (63.2)	204 (57.3)	
No changes	208 (40.9)	56 (36.8)	152 (42.7)	
Mask wearing frequency (h/week)				<b>0.017</b>
< 7	321 (63.2)	84 (55.3)	237 (67.1)	
7-28	92 (18.1)	30 (19.7)	62 (17.6)	
> 28	92 (18.1)	38 (25.0)	54 (15.3)	
Type of mask				0.290
N95 or KN95 mask	35 (6.9)	6 (3.9)	29 (8.1)	
Medical or surgical mask	460 (90.6)	144 (94.7)	316 (88.8)	
Other masks	10 (2.0)	2 (1.3)	8 (2.2)	

### ***Mask Wearing Frequency, Rather than the Mask Type, Was Associated with Acne Deterioration***

To further investigate the relationship between mask-wearing and acne aggravation, we explored a logistic regression model. The results showed that mask-wearing frequency was associated with age, irregular diet, outdoor activity restrictions, skin-care habits (including facial hygiene and makeup use), and upside-down circadian rhythms ( $p < 0.05$ ). Other covariates including therapy, mask type, and clinical characteristics had no significant correlation with mask-wearing (**Supplementary Table I**). After adjusting the significant factors aforementioned, compared to less frequent mask-wearing (<7 hours per week), more frequent or longtime mask-wearing (>28 hours per week) was positively associated with the worsening acne symptoms during the COVID-19 outbreak (OR: 2.164; 95% CI: 1.232-3.801) (Table III). However, the type of mask showed no significant correlation with the outcome.

### ***Interactive Effects***

To investigate if a healthier lifestyle could inverse the effects of mask-wearing on acne, interactions between mask-wearing and the known risk behaviors were evaluated. The statistically significant negative effects of frequent or longtime mask-wearing ( $p = 0.007$ , OR: 2.164; 95% CI: 1.232-3.801) on acne turned insignificant when coupled with a more consistent circadian rhythm, and reduction of sweet food ( $p = 0.943$ , OR: 1.048), dairy products ( $p = 0.611$ , OR: 0.704), spicy ( $p = 0.955$ , OR: 1.043) and greasy foods intake ( $p = 0.113$ , OR: 0.145).

## **Discussion**

Our investigations found that during the 2020 COVID-19 pandemic, patients with acne experienced worse symptoms. Unhealthy diet, including dairy, sweet, spicy, and greasy food consumption seemed to correlate closely with acne deterioration. In addition, we found that the frequency of wearing masks, rather than the type of mask, appeared to contribute to acne aggravation.

Acne is a chronic inflammatory disease of the pilosebaceous unit (hair follicles)<sup>2</sup>. Various studies<sup>6-9</sup> have noticed the close correlation between diet and acne. Among these, foods considered sweet, greasy, or spicy and dairy products were reported as risk factors of acne. Our investiga-

tion also verified these viewpoints. Based on our results, during the COVID-19 pandemic, many patients with acne had changes in their dietary habits. These changes may be due to stay-at-home quarantine orders and travel restrictions. The mechanisms for how these factors can deteriorate acne symptoms have been partially investigated. Dairy products and sweet foods can increase insulin-like growth factor-1 (IGF-1), which causes increased androgen-mediated sebum production<sup>10</sup>.

Additionally, we systemically reported the association between mask-wearing and acne and concluded that long-time mask wearing (>28 hours per week) was a significant risk factor for patients with acne. Recent studies<sup>4</sup> have shown that mask-wearing is associated with the deterioration of many skin diseases. There are also some evidence supporting that mask-wearing might worsen the symptoms of acne. For example, a study in Turkey<sup>11</sup> found that after wearing masks, a fivefold increase in acne complaints occurred. Concurrently, Pakistan researchers<sup>12</sup> have found that face mask use is associated with high rates of acne eruption in healthcare workers. Though similar reports<sup>13,14</sup> claimed masks exacerbated acne symptoms in China through the epidemic, these studies showed a relationship between mask-wearing and symptom deterioration but did not include mask wearing frequency or mask type and lacked a large sample size. Furthermore, most studies<sup>12,15,16</sup> more focused on healthcare workers, lacking a large public sample size. Similarly, there are reports<sup>17,18</sup> of acne aggravation in medical professionals caused by mask-wearing during severe acute respiratory syndrome (SARS), but there were no relevant reports in general population.

In the current study, we systemically analyzed the specific details of mask-wearing in a larger number of participants. We found the frequency of mask-wearing, rather than mask type influenced the symptoms of acne. Patients experienced acne deterioration when wearing masks for extended periods (>28 hours per week) independently of the type of mask worn.

The specific mechanisms about how mask-wearing affects acne are unknown. Based on the known pathogenesis, there are some possible explanations. First, wearing a mask may increase mechanical friction, which could damage the skin barrier. Alternatively, local pressure on the skin from the close-fitting masks may cause pilosebaceous duct occlusion<sup>18</sup>. Second-

**Table III.** Association of mask wearing behaviors with the deterioration of acne (N = 505).

Exposure	Unadjusted model		Adjusted model 1*		Adjusted model 2#	
	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>
Frequency of mask wearing (h/week)						
< 7	1		1		1	
7-28	1.365 (0.826, 2.255)	0.224	1.532 (0.884, 2.656)	0.129	1.568 (0.899, 2.734)	0.155
> 28	1.985 (1.224, 3.221)	0.005	2.089 (1.226, 3.559)	0.007	2.164 (1.232, 3.801)	0.007
Type of mask						
N95 or KN95 mask	1		1		1	
Medical or surgical mask	0.828 (0.139, 4.915)	0.825	0.896 (0.150, 5.349)	0.904	0.839 (0.138, 5.085)	0.848
Other masks	1.823 (0.382, 8.691)	0.451	1.838 (0.384, 8.795)	0.852	1.761 (0.365, 8.487)	0.481

CI, confidence interval; OR, odds ratio. \*Adjusted for age, sex, and dietary habits reported to have relationship with acne, including sweet, greasy, and spicy food and dairy products intake. #Further adjusted for outdoor activity restriction, skin-caring habits (including facial hygiene and wearing make ups) and upside-down circadian rhythms for acne.

ly, skin temperature and ambient humidity are associated with the aggravation of acne<sup>19</sup>. Wearing a mask for a long time could cause heightened skin temperature, which may exasperate symptoms. Likewise, sweating and increased humidity could cause swelling of epidermal keratinocytes, affecting the pilosebaceous follicle keratinocyte and causing acute obstruction and acne aggravation<sup>20</sup>. Furthermore, the skin microbiome is influenced by external factors such as environment, pH, and temperature, which are modified with mask wearing<sup>21</sup>. These above mechanisms could partially explain the dose-effect relationship between the mask-wearing time and acne.

Based on our results, it seems that limiting mask-wearing time is necessary to manage the acne symptoms. However, wearing masks in public daily has become necessary due to the prevalence of new strains of COVID-19. Fortunately, the interactive analysis results in our study have shown that healthier diets and sleep habits may counteract the influences of mask-wearing on acne. A healthier diet, including the reduction of dairy products, sweets, and spicy and greasy food consumption could, to some extent, reverse the effects of mask-wearing on acne. Similarly, going to bed regularly or avoiding staying up late could also mitigate acne symptoms.

In our study, many patients with acne expressed concerns about symptom aggravation due to various reasons, and they hoped that by acquiring skin-care knowledge, acne-related health and hygiene education, and online consultations would prevent acne deterioration. As mask-wearing has been shown to exasperate acne, we suggest patients with acne to avoid unnecessary social gatherings (where masks are required) for symptom-reducing purpose. With the healthy lifestyle benefits mentioned above, dermatologists should advise the patients with acne to adjust their daily lifestyles as best as they can, in order to reduce the effect of the obligatory mask wearing on acne. Providing detailed and personalized guidance or medical resources online could also help, especially during the home restriction period.

### **Limitations**

There are several limitations to our study. Compared to other web-based surveys, face-to-face consultations were not conducted, thus severity grading of acne was self-assessed by the patients and might be biased. Moreover, this cross-sectional study can only indicate correla-

tion, rather than a causal relationship. Prospective studies are needed to help the patients with acne to manage their symptoms as the COVID-19 is continuing to circulate worldwide.

### **Conclusions**

During the first COVID-19 outbreak in China, the overall symptoms of patients with acne worsened and deterioration was more common in patients who frequently wore masks (>28 hours per week). Healthy diets and sleep habits may weaken the effects of mask-wearing on acne. Avoiding social gatherings (where masks are required) and living a healthier lifestyle are suggested for patients with acne to better mitigate their symptoms.

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### **Conflict of Interest**

The Authors declare that they have no conflict of interests.

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### **Ethics Approval**

The study was conducted in accordance with the ethical standards of the Helsinki Declaration and was approved by the Institutional Review Board of Xiangya Hospital, Central South University (No. 202003026).

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### **Informed Consent**

All participants were given a full explanation of the study and informed consent was obtained electronically over the Internet.

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