

## ORIGINAL ARTICLE

# The development of acne vulgaris due to face masks during the pandemic, risk awareness and attitudes of a group of university students

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**Abstract**

**Background:** Recent work conducted with healthcare workers and middle-aged populations has recognized the association between acne vulgaris (AV) and mask-wearing.

**Objective:** This study aimed to evaluate the correlation between the face mask and AV in a group of university students, triggering factors, the awareness, and attitudes of the students.

**Methods:** A face-to-face survey was conducted to 200 participants (84 males, 116 females) who composed of third- and fifth-grade medical faculty students. The questionnaire compiled the demographic data, skin care habits, mask-wearing habits, skin lesions developed on their faces with the use of face masks, awareness, and attitudes of the students.

**Results:** The mean age of the participants was  $21.39 \pm 1.34$  (range, 19–26 years). While 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. Moreover, 90.5% of students stated that the face mask could cause the development of AV. The most frequent protective precautions of the students were the intermittent removal of face masks and regular handwashing.

**Conclusion:** The use of face masks triggers the development of AV in young people. Wearing masks over long periods of time without breaks and infrequently changing one's mask throughout the day may lead to the development of new or worsening of AV in young populations.

**KEYWORDS**

acne vulgaris, COVID-19, face mask, maskne, pandemic

## 1 | INTRODUCTION

In early December 2019, a highly contagious disease emerged in Hubei Province of China. The effects of the disease have been felt globally. Diagnostic and treatment protocols have been developed

by collecting epidemiological and clinical data over time. In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic. In Turkey, the first COVID-19 case was detected in March 2020, and as the pandemic progressed, the number of cases in Turkey and worldwide continually increased.

Along with the pandemic, dermatological diseases associated with COVID-19 infection began to appear. While these diseases were sometimes directly related to the COVID-19 infection, sometimes they developed due to the personal protective equipment. There are valuable reviews evaluating dermatological diseases associated with COVID-19 infection in the literature.<sup>1</sup> The disease appears to be transmitted by direct inhalation of contaminated droplets released into the environment by sneezing or coughing between individuals, or by the penetration of virus-containing secretions into the oral, nasal, and eye mucosa by direct or indirect contact. Using masks, maintaining hand hygiene, and complying with social distancing rules can prevent the spread of the infectious disease. However, the use of face masks as protective equipment might have some disadvantages. Prolonged mask use can result in various skin problems.<sup>1-9</sup> A variety of studies in the literature has investigated skin lesions that develop with the use of protective equipment or involved a limited group of participants, such as healthcare workers.<sup>4,5</sup> One of the diseases that develop due to face masks is acne vulgaris (AV).<sup>7-11</sup> However, since previously published studies mostly examined all the skin lesions, there has been no detailed investigation of the association between face masks and AV. Although AV is the most common skin disease among young people, no previous study has investigated the development of AV due to face masks in the young population. In the current study, we aimed to examine the development of AV due to the use of masks, triggering factors, and also risk awareness and attitudes of a group of university students.

## 2 | MATERIALS AND METHODS

This study was carried out at a university faculty of medicine in Turkey. Totally 200 participants (84 males, 116 females) who composed of third- and fifth-grade medical faculty students and agreed to participate in the study were included in this research. A face-to-face survey was conducted to the students. The questionnaire was designed to measure the following constructs: the demographic data of the students (i.e., age and gender), the presence of dermatological diseases, skin care habits (i.e., face washing frequency and products used), mask-wearing habits (i.e., total mask-wearing time per day, maximum duration of wearing of face masks, the average daily number of masks, type of masks). Students were asked to indicate which skin lesions/symptoms (AV, oily skin, pruritus, erythema, xerosis, tenderness, burning, sunken nose, and edema) have been developed on their faces because of the use of face masks. The questionnaire also consisted of some questions related to AV, including the previous history of AV, location of AV on the face, and whether AV has been developed due to the use of face masks. Furthermore, the students were required to answer whether they had AV before the use of face masks and there were any changes in their symptoms. The duration of the complaints of the participants with AV was questioned. Their treatment status for AV was examined. We excluded participants with facial dermatoses other than AV and known allergies.

In Turkey, as in many parts of the world, the pandemic prompted virtual learning. The number of people who have been vaccinated has increased over time, and therefore, the education system has begun to transition back to face-to-face teaching environment. Thus, the frequency of mask use among young individuals has increased even more, and they have had to wear face masks for a long time. In the questionnaire, the developmental status of AV was asked after the face-to-face education started. To investigate the students' awareness of the risk of developing AV, the students were required to answer whether wearing face masks would influence the development of AV. They were also questioned about which precautions they took to prevent dermatological disorders on their face (i.e., regular handwashing, regular facial washing, stopping wearing foundation, using surgical masks, frequent change of masks, intermittent removal of face masks, applying face moisturizers, washing fabric masks daily). This study was approved by Baskent University Institutional Review Board (Project no: KA21/396). All the participants gave informed consent for the publication of their data.

### 2.1 | Statistical analysis

Statistical analysis was performed with SPSS (Statistical Package for the Social Sciences; software version 23, SPSS Inc.). Descriptive statistics were shown with number and percentage for categorical variables, mean  $\pm$  SD, and/or median (min-max) for continuous variables. The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk's test) to determine whether or not they are normally distributed. To compare categorical groups with having or not AV, Chi-Square test was performed. Mann-Whitney U test was performed for not-normally distributed parameters for all continuous variables because none of the parameters have distributed normally. The possible risk factors for the development of AV associated with using face masks were further entered into the binary logistic regression analysis with Enter model. Hosmer-Lemeshow goodness of fit statistics was used to assess model fit. Odds ratio values are presented with a 95% confidence interval (CI). A significance level of  $p < 0.05$  was adopted.

## 3 | RESULTS

The mean age of the participants was  $21.39 \pm 1.34$  (range, 19-26 years). Their skin care habits and mask-wearing habits are summarized in [Table 1](#).

Facial skin changes due to masks and features of students' AV during the pandemic and AV-related risk awareness and attitudes among these students are summarized in [Table 2](#).

135 (65.5%) of the participants had AV. The mean time of having AV was  $16.43 \pm 29.09$  months (range, 1-120). 20 of these students were receiving AV treatment (three patients; systemic retinoic acid, 14 patients; topical antibiotics and comedolytics,

TABLE 1 The facial care and mask usage habits of patients

	n (%)	Mean ± SD (range)
<b>Facial care habits</b>		
Frequency of daily face wash (time)		2.21 ± 1.03(0-7)
Products used in face wash		
Washing gel	116 (58%)	
Just water	44 (22%)	
Soap	40 (20%)	
Daily use of moisturizer		
Yes	119 (59.5%)	
Daily use of foundation		
Yes	54 (27%)	
Daily doing makeup		
Yes	60 (30%)	
<b>Mask usage habits</b>		
Duration time of wearing of mask (hour)		3.61 ± 2.3 (1-10)
Total mask-wearing time per day (hour)		8.66 ± 1.82 (4-14)
Number of masks used per day		1.68 ± 0.72 (1-6)
Type of mask used		
One surgical mask	140 (70%)	
N95/FFP2 mask	28 (14%)	
N95/FFP2 + surgical mask	14 (7%)	
Two surgical mask	11 (5.5%)	
Cloth mask	7 (3.5%)	

Abbreviations: n, number; SD, standard derivation.

three patients; topical antibiotics). Parameters that might be related to the development of AV during the pandemic are evaluated in Table 3.

Logistic regression analysis of factors associated with the development of AV during the pandemic is summarized in Table 4.

The results of this study demonstrated that being female is one of the effective factors in the development of AV since women are 2.361 times more at risk of developing AV lesions than men. There was a significant positive correlation between the development of AV and the duration of mask-wearing without changing to a new one during the day. Using the same mask for a prolonged period without removing it increases the risk of developing AV by 1314 times. A statistically significant relationship was also found between the average daily number of masks and the development of AV. As the total number of masks used per day increases, the risk of the development of AV decreases by 1779 times (1/OR value was used because of OR <1). Frequencies of daily face washing, daily use of washing gel, daily use of moisturizers, daily use of foundation, and daily doing makeup were not found to be risk factors for the development of AV.

TABLE 2 Facial skin changes due to mask, features of students' acne vulgaris during the pandemic and acne vulgaris risk awareness-attitudes among students

	n (%)
<b>Skin changes on the face due to mask use<sup>a</sup></b>	
Acne vulgaris	125 (62.5%)
Oily skin	74 (37%)
Pruritus	71 (35.5%)
Erythema	52 (26%)
Xerosis	41 (20.5%)
Tenderness	28 (14%)
Burning	11 (5.5%)
Sunken nose	10 (5%)
Edema	4 (2%)
<b>Relationship between mask use and acne vulgaris</b>	
No acne vulgaris	67 (33.5%)
Had acne vulgaris, remained the same after using the mask	11 (5.5%)
Had acne vulgaris and increased with the use of mask	41 (20.5%)
No acne vulgaris but developed with the use of mask	81 (40.5%)
<b>Localization of acne vulgaris<sup>a</sup></b>	
Cheek	102 (51%)
Chin	91 (45.5%)
Forehead	35 (17.5%)
Nose	18 (9%)
<b>Acne vulgaris risk awareness-attitudes</b>	
Increase/Development of acne vulgaris during face-to-face education	104 (52%)
Thinking mask should trigger the development of acne vulgaris	181 (90.5%)
Taking precautions to prevent the development of skin lesions due to mask use <sup>a</sup>	
Yes	108 (54%)
Removing the mask intermittently	82 (41%)
Regular hand washing>	74 (37%)
Using a moisturizer>	59 (29.5%)
Regular face washing	57 (28.5%)
Using surgical masks	54 (27%)
Not applying foundation	31 (15.5%)
Changing masks frequently	23 (11.5%)
Washing the cloth mask daily	2 (1%)

Abbreviation: n, number.

<sup>a</sup>Some participants had more than one skin change/ AV location and had more than one precaution.

## 4 | DISCUSSION

Standard, droplet, and contact isolation precautions are required to prevent and control for the contamination of COVID-19. Face

TABLE 3 Parameters that may be related to the development of acne vulgaris in the pandemic

Parameters that may be related to the development of acne vulgaris <sup>a</sup>	Acne Vulgaris		$\chi^2$	p	Z
	Have Not Acne	Have acne			
Age	21 (19–26)	22(19–25)		0.392	-0.856
Gender			<b>11.582</b>	<b>0.001</b>	
Female	32 (27.6%)	84 (72.4%)			
Male	43 (51.2%)	41 (48.8%)			
Frequency of daily face wash	2 (1–7)	2 (0–6)		0.098	-1.654
Total mask-wearing time per day (hour)	8 (4–14)	9 (4–14)		0.929	-0.089
Duration time of wearing of mask (hour)	2 (1–10)	4 (1–10)		<b>&lt;0.001</b>	<b>-4.017</b>
Number of masks used per day	2 (1–6)	2 (1–4)		<b>0.023</b>	<b>-2.266</b>
Daily use of washing gel			<b>7.904</b>	<b>0.005</b>	
No	41 (48.8%)	43 (51.2%)			
Yes	34 (29.3%)	82 (70.7%)			
Daily use of moisturizer			<b>8.201</b>	<b>0.004</b>	
No	40 (49.4%)	41 (50.6%)			
Yes	35 (29.4%)	84 (70.6%)			
Daily use of foundation			0.548	0.459	
No	57 (39.1%)	89 (60.9%)			
Yes	18 (33.3%)	36 (66.6%)			
Daily doing makeup			0.635	0.426	
No	55 (39.2%)	85 (60.7%)			
Yes	20 (33.3%)	40 (66.6%)			
Type of mask used			0.935	0.919	
One surgical mask	3 (42.9%)	4 (57.1%)			
N95/FFP2 mask	50 (35.7%)	90 (64.3%)			
N95/FFP2 + surgical mask	5 (45.5%)	6 (54.5%)			
Two surgical mask	12 (42.9%)	16 (57.1%)			
Cloth mask	5 (35.7%)	9 (64.3%)			
Taking precautions to prevent the development of skin lesions due to mask use			2.598	0.107	
No	40 (43.5%)	52 (56.5%)			
Yes	35 (32.4%)	73 (67.6%)			
Removing the mask intermittently			0.138	0.171	
No	43 (36.4%)	75 (63.6%)			
Yes	32 (39%)	50 (61%)			
Regular hand washing			<b>5.497</b>	<b>0.019</b>	
No	55 (43.7%)	71 (56.3%)			
Yes	20 (27%)	54 (73%)			
Using a moisturizer			1.348	0.246	
No	57 (40.4%)	84 (59.6%)			
Yes	18 (30.5%)	41 (69.5%)			
Regular face washing			0.865	0.352	
No	57 (39.9%)	86 (60.1%)			
Yes	18 (31.6%)	39 (68.4%)			
Using surgical masks			0.331	0.565	
No	57 (39%)	89 (61%)			
Yes	18 (33.3%)	36 (66.7%)			

TABLE 3 (Continued)

Parameters that may be related to the development of acne vulgaris <sup>a</sup>	Acne Vulgaris		$\chi^2$	<i>p</i>	Z
	Have Not Acne	Have acne			
Not applying foundation			0.736	0.391	
No	66 (39.1%)	103 (60.9%)			
Yes	9 (29%)	22 (71%)			
Changing masks frequently			0.16	0.689	
No	65 (36.7%)	112 (63.3%)			
Yes	10 (43.5%)	13 (56.5%)			
Washing the cloth mask daily				<b>0.529<sup>b</sup></b>	
No	75 (37.9%)	123 (62.1%)			
Yes	0	2 (100%)			

Abbreviation: n, number.

<sup>a</sup>Continuous data are reported as median (interquartile range) and categorical data as number (%).

<sup>b</sup>Fischer exact test is applied.

Statistically significant values are written in bold. A significance level of  $p < 0.05$  was adopted.

TABLE 4 Logistic regression analysis of factors associated with acne development during the pandemic

Factors associated with acne development	B	S.E.	Wald	<i>p</i> Value	OR	95% CI	
						Lower	Upper
Constant	0.996	0.829	1.443	0.230	2.706		
Gender	0.859	0.428	4.032	<b>0.045</b>	2.361	1.021	5.461
Frequency of daily face wash (min-max)	-0.120	0.162	0.553	0.457	0.887	0.646	1.218
Daily use of washing gel	-0.287	0.386	0.554	0.456	0.750	0.352	1.598
Daily use of moisturizer	-0.161	0.406	0.158	0.691	0.851	0.384	1.885
Duration time of wearing of mask	0.273	0.081	11.293	<b>0.001</b>	1.314	1.121	1.541
Number of masks used per day	-0.576	0.245	5.531	<b>0.019</b>	0.562	0.348	0.909
Regular hand washing	-0.669	0.368	3.308	0.069	0.512	0.249	1.053

Note: Reference variables: Gender, female; daily use of washing gel, no use; daily use of moisturizer, no use; regular hand washing, no use. Model information: Method: Enter; Classification, overall percentage: 68.5; Model Chi-square: 38640; d.f.:8;  $p < 0.001$ , Hosmer and Lemeshow Test: 12946. Abbreviations: CI, confidence interval; OR, Odds ratio; SE, standard error.

Statistically significant values are written in bold. A significance level of  $p < 0.05$  was adopted.

masks are the most commonly used equipment for contamination protection. During the pandemic, various adverse skin reactions to prolonged mask use have been reported.<sup>1-9</sup> One of the most common reactions is the development of AV.<sup>10-16</sup> Our understanding of mask-related AV, also known as maskne, is largely observational, although it is probably recognized as a subtype of acne mechanica. The friction between face masks and the skin leads to warmth on the mask area, increases in humidity level, and irritates the skin. Increased humidity might worsen AV by causing occlusion of pores and injure the upper pilosebaceous unit of human skin. Sweating and increased humidity also might cause swollen keratinocytes, which leads to clogged follicles. Mechanical rupture of comedones by pressure and friction might provoke inflammation. Moreover, some changes in the skin's sebum composition, including elevated carbon dioxide levels and humidity, play an important role in the bacterial

proliferation. Bacterial growth in clogged and irritated pores might lead to the development of AV. Besides the risk of clogged pores, the friction produced by the use of face masks might damage the protective barrier of the skin and disturb its moisture balance. Maskne is a disorder of follicular occlusion, and it is directly related to the mechanical stress caused by pressure, occlusion, and friction. It is also associated with microbiome dysbiosis due to heat, pH, moisture from biofluids.<sup>9,15</sup>

Maskne is more well-known comorbidity in healthcare workers than in the general population since they mostly use face masks as personal protective equipment.<sup>4,5</sup> There is little published data on the role of face masks in the development of AV. The average age in almost all of these studies is above the 30s, and these studies usually involve healthcare workers or the general population.<sup>2,3,6,10,17</sup> Young individuals are more prone to the development of maskne. However,

as far as we know, there is no study in the existing literature examining the development of mask-related acne in the population under the age of 25.

Studies examining the changes in the diagnosis of admission to the dermatology outpatient clinic suggest that the increasing number of diseases may be related to the use of face masks. Kutlu et al. investigated the applications to the dermatology clinic during the pandemic and found one of the increasing applications as AV.<sup>17</sup> Roongpisuthipong et al.<sup>2</sup> examined the changes in the number and reason of visits to the dermatology clinic during the pandemic by looking at the hospital admission codes. The findings of the study indicated that while the number of visits to the dermatology clinic did not show any change, a difference was detected in the diseases observed. One of the diseases with increasing frequency was AV. However, this study, similar to other studies, includes patients with average age over 50. Metin et al.<sup>18</sup> investigated the dermatological complaints that changed during the pandemic. They distributed a questionnaire to 526 healthcare professionals and found that the frequency of AV increased. In their studies, the mean age was 34 years, and being under 30 years old and female gender were found to be risk factors for the development of AV. Chaiyabutr et al.<sup>19</sup> also concluded that being female was significantly associated with adverse skin reactions due to the use of face masks, including AV. Akl et al.<sup>1</sup> evaluated the skin findings due to COVID-19 infection and also personal protective equipment in their recently published review. Female gender and age (young adults) have been reported as important risk factors in terms of skin findings related to personal protective equipment. Similar to these studies, the findings of our study indicated that women are more than twice at risk of developing AV compared with men.

Maskne may occur in people who have a history of AV as well as those who had no history of AV.<sup>20</sup> Akl et al.<sup>1</sup> denoted that personal protective equipment use was found to exacerbate pre-existing diseases including AV. In our study, 40.5% of the participants had new AV development, while 20.5% of students had exacerbation of pre-AV. The prevalence of AV in our study after the use of face masks was 61% compatible with 59.6% reported by Foo et al.<sup>10,11</sup> and 56% shown by Purushothaman. However, there are also other studies in the literature in which the incidence of AV development is less common. Choi et al.<sup>6</sup> surveyed at 12 hospitals, and the authors demonstrated that the disease most frequently triggered by face masks was AV (46.7%). Techasatian et al.<sup>16</sup> also concluded that face masks led to adverse reactions in about half of the people, and 40% of these reactions were AV. In a survey conducted with 1231 participants, Chaiyabutr et al.<sup>19</sup> observed that adverse skin reactions related to the use of face masks were more common in patients under the age of 40, which one of them was AV. They found the exacerbation in AV as 32%. This is one of the rare studies in which the association between AV and face masks is examined under the age of 40.

While face masks have their advantages, our study showed that prolonged mask use without taking a break causes the development of AV. The total masked time during the day was not related to the development of AV. It was observed that while the students

remained masked for approximately 4 h without interruption, they remained masked for an average of 9 h totally in a day. In the light of this important information, it can be suggested to young people that even if they have to wear a mask for a long time during the day, the intermittent removal of face masks under safe conditions will reduce the risk of AV development. Akl et al., Chaiyabutr et al., Daye et al., and Choie et al. denoted that longer durations of wearing masks increased AV flare-ups.<sup>1,4,6,9</sup> Techasatian et al.<sup>16</sup> showed that wearing a mask for 4–8 h/day and more than 8 h/day increased the risk of adverse skin reactions. Yaqoob et al.<sup>14</sup> reported that there was no significant relationship between the development of AV and the duration of the mask worn per day. No previous study has investigated the association between the risk of development of AV and the total duration of mask-wearing during the day and also the duration of intermittent masking behavior. It is also not clear what they mean by mask-wearing time in most of the studies.

One of the other important parameters is the total number of masks used during the day. It was concluded that students were using less than two masks during the day. Furthermore, the findings of this study showed that an increase in the number of masks worn daily reduces the risk of the development of AV. However, according to Yaqoob et al.<sup>14</sup> there was no significant relationship between the development of AV and the frequency of the face masks worn per day. Techasatian et al.<sup>16</sup> showed that the disposition of not changing the mask after use every day was another risk factor for adverse skin reactions including AV.

Many types of masks can be used in daily life. It was observed that three-quarters of the students preferred a single surgical mask in our study. In the literature, the results about the relationship between mask type and AV development are contradictory. Doğan et al.<sup>21</sup> found no relationship, as in our study. But Yaqoob et al. and Foo et al.<sup>11,14</sup> found a correlation between N-95 mask and the development of AV. Comparing the adverse skin reactions between different types of masks, Chaiyabutr et al.<sup>19</sup> reported that the risk of the development of AV caused by the use of surgical masks was higher than that of fabric masks. Techasatian et al.<sup>16</sup> demonstrated that wearing a surgical mask showed a higher risk of adverse skin reactions including AV compared with a fabric mask. Choie et al.<sup>6</sup> found that the use of cotton face masks increased acne flare-ups. In our study, there was no significant difference in the development of AV among all mask types.

In our study, AV was the most common facial skin change among mask-wearing students. Two-thirds of them developed AV. Oily skin and pruritus were also observed in one-third of the participants. It was shown that young people attach importance to skin care and have regular face washing and moisturizing habits. However, we found no relationship between skin care habits and the development of AV. As in our study, Metin et al.<sup>18</sup> found no relationship between the frequency of face washing and the development of AV. About a third of the students were applying makeup and using foundation, but this was not significant in terms of AV development. In our study, the most common areas of AV were the cheeks and chin. AV lesions were present in approximately half of the patients in these areas.

Yaqoob revealed that cheeks were the most frequent site in HCW similar to our study.<sup>14</sup>

As many of the young population continue their educations, the frequency of mask-wearing among young individuals has increased even more and they have had to wear face masks for a long time. Half of the students stated that their acne lesions occurred when they transitioned from online to face-to-face learning. Moreover, almost all of the students stated that there was a relationship between the use of face masks and the development of AV. However, only half of them took action against it. The most common precaution they took was to remove their masks intermittently, which seems to be an effective precaution. However, frequent mask changes, one of the effective measures, were carried out only by a small part of the students. Our research is essential since it includes a large-scale study group that reflects the association between mask-wearing and the development of AV in young individuals. Youths have a predisposition for the development of AV. The risk of developing AV can be reduced by taking some necessary precautions. Informing the individuals in the risk group about the proper use of face masks might be protective against the development of AV. Protective precaution can be taken for the development or exacerbation of AV due to mask-wearing, especially with the transition to face-to-face education, and recommendations regarding the use of face masks can be given to patients while planning the treatment of AV.

The limitation of our study is that participants were not followed up and evaluated prospectively. Also, the study group consisted of young people studying in medical school, and therefore, they may be more knowledgeable about mask-wearing habits than their age group.

## 5 | CONCLUSION

The use of face masks triggers the development of AV in young people. In this respect, women are more at risk. The most common AV development is seen on the cheeks and chin. Prolonged use of face masks without taking a break and using few masks daily by the young population during the pandemic might lead to the development of new or worsen pre-existing AV. Dermatologists need to be aware of the relationship between face masks and the development of AV. In line with this study, the clinicians might deal with these problems in the young population by encouraging proper mask-wearing behaviors, which is an essential means of prevention against COVID-19. This study gives some clues about the impact of mask-wearing on the development of AV, which might affect our preventive recommendations and treatment approaches.

### CONFLICT OF INTEREST

None.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### ETHICAL APPROVAL

This study was approved by Baskent University Institutional Review Board (Project no: KA21/396).

### INFORMED CONSENT

All the participants gave informed consent for the publication of their data.

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