


# Impacts of COVID-19 Pandemic on Dermatology Outpatient Department at a Tertiary Hospital in Eastern China: A Pre-Post Study

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**Background:** The COVID-19 pandemic has considerable impact on health care system in the world directly. Although the pandemic has been effectively controlled, people's lifestyle, stress of job, economic status and health conditions have all changed. Therefore, it is unclear whether the COVID-19 pandemic has affected the distribution of diseases in dermatology outpatient department, especially in the post-pandemic era and how we should respond to these changes.

**Objective:** We aimed to assess the impact of the COVID-19 pandemic on diagnosis of dermatology outpatient department in eastern China.

**Methods:** A pre-post study design was a retrospective study to assess the changes of diseases diagnoses from the outpatient department of Dermatology, Taicang first people's hospital, Suzhou University, Suzhou, China in the 2021 (Post-COVID-19 pandemic) compared to the 2019 (Pre-COVID-19 pandemic). Statistical analysis was performed using the SPSS 23.0 and Excel 2010. The data were analysed by methods independent *t*-test and Pearson's chi-square test. A two-sided *p*-value of <0.05 was considered statistically significant.

**Results:** A total of 67,994 patients in 2019 and 67,288 patients in 2021 were included in the study. During the pre-pandemic year, the most common diagnoses in the outpatient department were urticaria, fungal dermatitis, acne, herpes zoster, seborrheic dermatitis. Urticaria, acne, allergic dermatitis, fungal dermatitis, herpes zoster, were statistically more common in the post-pandemic period. Acne, animal-related diseases, allergic dermatitis, insect dermatitis, alopecia, and verruca vulgaris diagnoses were found to increase statistically during the post-pandemic period when compared with the pre-pandemic period.

**Conclusion:** The COVID-19 pandemic had a minimal effect on the average yearly dermatology outpatients department visits, but the distribution of dermatology diagnoses was affected. As a result, governments and health departments may introduce innovative ways and training of medical teams according to the impact of the pandemic to ensure normal medical care.

**Keywords:** COVID-19 pandemic, dermatology outpatient, dermatologic diseases, diagnostic distribution, pre-post study

## Introduction

Since the outbreak of coronavirus-2019 (COVID-19) in December 2019, China has immediately implemented a number of measures, including "social distancing" and "at home" orders. The World Health Organization (WHO) named the disease as COVID-19 in February 2020.<sup>1</sup> It has affected many countries in a short period of time, and has quickly spread worldwide on March 11, 2020, then the WHO declared an COVID-19 pandemic.<sup>2</sup> Worldwide, COVID-19 outbreaks do have direct and indirect effects, and pandemic in different regions have affected the social and economic well-being relationships of communities.<sup>3</sup> While health systems in many countries and regions around the world are overwhelmed, resulting in a significant increase in direct and indirect mortality from vaccine-preventable or treated

diseases.<sup>4</sup> There was evidence that the COVID-19 pandemic has severely disrupted health-care services, especially in resource-limited countries.<sup>5</sup> With the direct impact of the COVID-19 pandemic puts the health-care system indirectly beyond its capacity, potentially lasting side effects in the health service system, even in countries where the outbreak is well controlled.<sup>6</sup>

Since 2021, the COVID-19 pandemic in Chinese mainland has been almost under control, especially in eastern China, where few new COVID-19 cases have been reported in 2021.<sup>7</sup> Although there are no new cases, people's lifestyle, medical treatment patterns and medical insurance have changed more or less than those before the pandemic.<sup>8,9</sup> Previous studies have revealed many differences between dermatology outpatient diagnosis before the pandemic outbreak and diagnosis distribution during the pandemic period.<sup>10-13</sup> However, there was a blank in study comparing the distribution of outpatient disease diagnosis and the characteristics of patients in dermatology before and after the pandemic outbreak. Our study aimed to evaluate the changes in patient characteristics and distribution of disease diagnosis of dermatology outpatient visits in the post-pandemic era compared to pre-pandemic era. As one of the regions with the highest per capita income in China, the Yangtze River Delta region is not only leading over other regions in economy, but also has a high-quality representation in culture, education, medical care and other aspects. We believe that the research can inform dermatologists and public health departments about this trend and be more fully prepared for the post-pandemic era.

## Materials and Methods

### Study Design, Settings, and Participants

Given the Chinese mainland pandemic, the main outbreak occurred in 2020, so the study defined two time periods, pre-pandemic period (2019), and post-pandemic period (2021). This study was a retrospective study in a tertiary hospital in Eastern China. The dermatology outpatient department of the hospital admitted 67,994 patients during 2019 and 67,288 patients during 2021. To assess the number of patients and diagnosis distribution presenting to the dermatology outpatient department at different periods. Inclusion criteria: All patients who visited the dermatology outpatient department for skin-related diseases between January 2019 and December 2019 and between January 2021 and December 2021. Exclusion criteria: Patients with incomplete data records and non-skin-related diseases.

### The Definition of the Disease Diagnosis

The International Classification of Diseases, 10th Edition (ICD-10) code identifies diagnosed dermatology in patients. The ICD-10 code was classified into 19 different dermatological categories, including Acne, Epifolliculitis, Psoriasis (all types), Erythema & Squamous skin disease, Skin infections, Hair disorders and nail disorders, Neoplasms, Pigmentary disorders, Vascular skin disorders, Bullous dermatosis, Dermal connective tissue diseases, Pruritic skin disease, Dermatitis medicamentosa and drug rash, Animal-related diseases, Urticaria-related diseases, Physical dermatitis, Others (undefined). In the diagnosis of Skin infections, which was divided into four sub-categories (Bacterial skin disease, Virus dermatopathy, Fungal dermatopathy, Other skin infections), and all 19 diagnoses were again classified into 103 minor classification diagnoses.

All diagnoses were based on the patient's first diagnostic definition if multiple diagnoses existed presenting the patient. Patients who returned for review due to the same diagnosis within 30 days after the first visited will not be included.

### Data Collection and Ethics

In the study, the files of patients admitted to outpatient dermatology department were extracted retrospectively through the hospital automated information system. To obtain an accurate diagnosis, all patients' dermatological visited records were reviewed by three dermatologists. The variables of age, gender, clinic diagnosis, and medical insurance status were recorded for all patients. All methods were performed in accordance with the relevant guidelines and regulations.

## Statistical Analysis

All statistical procedures were performed using the IBM SPSS statistical software<sup>®</sup> 23.0 and MS Excel<sup>®</sup> 2010. For continuous data, the mean and standard deviation were used to describe normally distributed data and were compared using the independent *t*-test. Abnormally distributed measurement data were summarised by median (interquartile range) and were used by Mann–Whitney *U*-test. Frequency and percentage were used for categorical data, which were compared using the Pearson's chi-square test. A two-sided *p*-value of <0.05 was considered statistically significant.

## Results

### General Patient Characteristics

A total of 67,994 patients attended the dermatology outpatient department during the year before the COVID-19 pandemic outbreak. Then, in 2020, the Chinese government reported first confirmed case of COVID-19 and implemented regulation of home quarantine. Outpatient visits to dermatology outpatient department decreased as people were instructed to stay at home. In the second half of 2020, with the lifting of the lockdown, the number of visits in 2021 returned to normal in China. In a post-COVID-19 pandemic, 67,288 patients presented to the dermatology outpatient department in 2021 compared with pre-pandemic. The median age of outpatients pre-pandemic was 31 years, and it was 32 years in the post-pandemic (*p* = 0.109). According to the age category, study showed that the number of child patients (younger than 14 years old) pre-pandemic was significantly higher than that post-pandemic, but the number of adults (younger than 65 years old) was significantly lower than that after the outbreak, then the number of elderly patients (greater than 65 years old) was not significantly different between the pre-pandemic and post-pandemic.

There was no significant difference in the gender of the patients seen before and after the outbreak COVID-19 pandemic. In 2019, the number of male patients was 35,623 (52.4%), and 35,173 (52.3) male patients were presented to the dermatology outpatient department in 2021 (*p*=0.661).

Among them, the proportion of patients with medical insurance before the outbreak of the pandemic was lower than that in the post-pandemic era, with 66.2% in 2019 and 71.2% in 2021. Demographic data are presented in [Table 1](#).

### Prevalence of Distribution of Diagnosed Skin Diseases at Dermatology Outpatient Department of the Hospital Pre- and Post-COVID-19 Pandemic

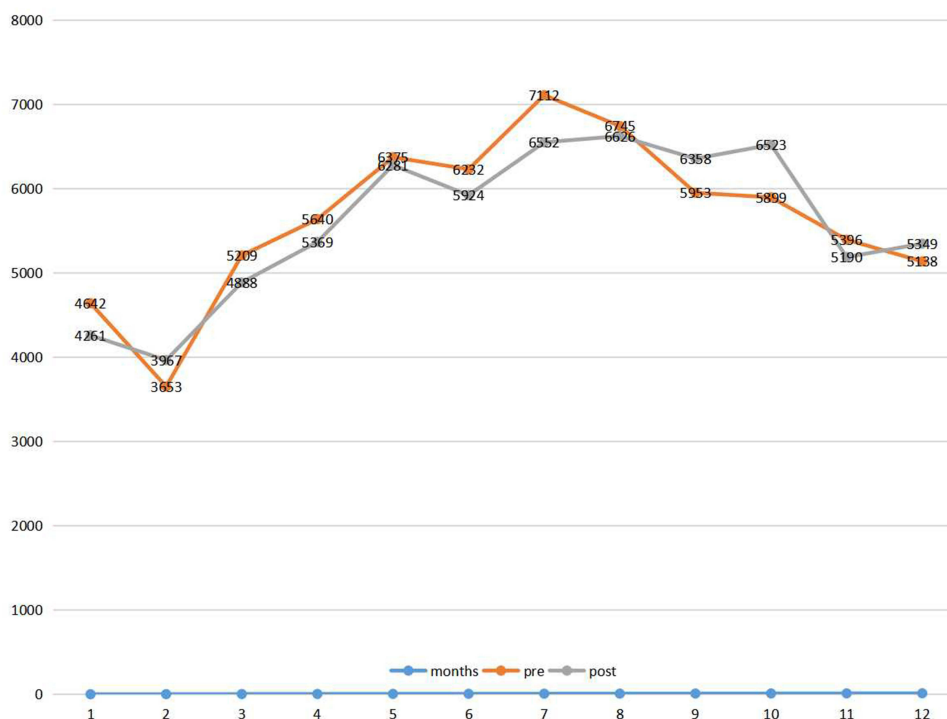
The trend of the number of dermatology clinic visited in the same month was similar, indicated that the outbreak of the COVID19 did not significantly change the number of patients ([Figure 1](#)).

After determination, the total number of diagnoses was 126, including 29 primary classification and 103 secondary classification ([Table 2](#)), which showed that in 2019 year, diagnoses with the largest number of visited by the secondary-level classification criteria were urticaria, fungal dermatitis, acne, herpes zoster, seborrheic dermatitis. But urticaria, acne, allergic dermatitis, fungal dermatitis, herpes zoster, were statistically more common in the post-pandemic period. The 51 kinds of skin diseases diagnoses more were significantly changed in the two periods, among them 22 kinds of diagnoses

**Table 1** Demographic and Characteristics of Patients

|                         | Pre-Pandemic  | Post-Pandemic | P-value |
|-------------------------|---------------|---------------|---------|
| Male (N,%)              | 35,623 (52.4) | 35,173 (52.3) | 0.661   |
| Age (y)                 | 31 [20;46]    | 32 [21;45]    | 0.109   |
| <14                     | 12,378 (18.2) | 11,118 (16.5) | <0.001  |
| 14–64                   | 50,973 (75.0) | 51,725 (76.9) | <0.001  |
| ≥65                     | 4639 (6.8)    | 4445 (6.6)    | 0.110   |
| Medical insurance (N,%) | 44,994 (66.2) | 47,916 (71.2) | <0.001  |

**Note:** Data are presented as N (%) and median interquartile range in parentheses.



**Figure 1** The number of dermatology clinic visits per month in 2019 and 2021. The number of the patients are represented by the vertical lines. The orange line represents 2019, and the gray line represents 2021.

were more in post-pandemic than pre-pandemic and 29 kinds of diagnoses were less than pre-pandemic (Figure 2). Acne, animal-related diseases, allergic dermatitis, insect dermatitis, alopecia, and verruca vulgaris diagnoses were found to increase statistically during the post-pandemic period when compared with the pre-pandemic period. The diagnoses of other types of dermatitis (undefined), urticaria, fungal dermatitis, herpes zoster, other skin infections were decreased in the post-pandemic compared to pre-pandemic.

**Table 2** Changes in the Frequency of Diseases in Dermatology Outpatient Department Between Pre- and Post-COVID-19 Pandemic

| Diagnoses             | Pre-Pandemic (N,%) | Post-Pandemic(N,%) | P-value |
|-----------------------|--------------------|--------------------|---------|
| Acne                  | 2750 (4.0)         | 3328 (4.7)         | <0.001  |
| Epifolliculitis       | 897 (1.3)          | 1169 (1.7)         | <0.001  |
| Psoriasis (all types) | 699 (1)            | 598 (0.9)          | 0.009   |
| Others (undefined)    | 937 (1.4)          | 1010 (1.5)         | 0.058   |
| Dermatitis            | 28,445 (41.8)      | 27,072 (40.2)      | <0.001  |
| Allergic dermatitis   | 2083 (3.1)         | 3193 (4.7)         | <0.001  |
| Dyshidrosis           | 157 (0.2)          | 201 (0.3)          | 0.015   |
| Contact dermatitis    | 322 (0.5)          | 358 (0.5)          | 0.128   |
| Eczema                | 10,079 (14.8)      | 9968 (14.8)        | 0.961   |
| Atopic dermatitis     | 8 (0)              | 25 (0)             | 0.003   |

(Continued)

Table 2 (Continued).

| Diagnoses                             | Pre-Pandemic (N,%) | Post-Pandemic(N,%) | P-value |
|---------------------------------------|--------------------|--------------------|---------|
| Seborrheic dermatitis                 | 2164 (3.2)         | 2192 (3.3)         | 0.435   |
| Seborrheic eczema                     | 218 (0.3)          | 154 (0.2)          | 0.001   |
| Steroid dependent dermatitis          | 132 (0.2)          | 97 (0.1)           | 0.025   |
| Acroposthitis and balanitis           | 540 (0.8)          | 415 (0.6)          | <0.001  |
| Cheilitis                             | 227 (0.3)          | 205 (0.3)          | 0.341   |
| Vericose dermatitis                   | 1 (0)              | 36 (0.1)           | <0.001  |
| Fungal dermatitis                     | 3376 (5)           | 2551 (3.8)         | <0.001  |
| Diaper dermatitis                     | 50 (0.1)           | 26 (0)             | 0.070   |
| Lichenoid dermatitis                  | 15 (0)             | 29 (0)             | 0.032   |
| Stasis dermatitis                     | 109 (0.2)          | 80 (0.1)           | 0.041   |
| Other types of dermatitis (undefined) | 8964 (13.2)        | 7542 (11.2)        | <0.001  |
| Erythema & Squamous skin disease      | 1456 (2.1)         | 1934 (1.5)         | <0.001  |
| Lichen planus                         | 39 (0.1)           | 22 (0)             | 0.033   |
| Pityriasis simplex                    | 677 (1)            | 375 (0.6)          | <0.001  |
| Erythema multiforme                   | 227 (0.3)          | 243 (0.4)          | 0.394   |
| Gibert's disease                      | 513 (0.8)          | 394 (0.6)          | <0.001  |
| Skin infections                       | 17,623 (25.9)      | 17,742 (26.4)      | 0.060   |
| Bacterial skin disease                | 567 (0.8)          | 542 (0.8)          | 0.562   |
| Erysipelas                            | 144 (0.2)          | 166 (0.2)          | 0.179   |
| Furuncle and carbuncle                | 105 (0.2)          | 99 (0.1)           | 0.729   |
| Acne rosacea                          | 8 (0.1)            | 86 (0.1)           | 0.994   |
| Urethritis                            | 105 (0.2)          | 93 (0.1)           | 0.435   |
| Impetigo                              | 109 (0.2)          | 76 (0.1)           | 0.018   |
| Palmoplantar pustulosis               | 17 (0)             | 22 (0)             | 0.405   |
| Virus dermatopathy                    | 6602 (9.7)         | 6448 (9.6)         | 0.429   |
| Flat wart                             | 318 (0.5)          | 318 (0.5)          | 0.895   |
| Viral rash                            | 745 (1.1)          | 286 (0.4)          | <0.001  |
| Molluscum contagiosum                 | 336 (0.5)          | 260 (0.4)          | 0.003   |
| Herpes zoster                         | 2591 (3.8)         | 2281 (3.4)         | <0.001  |
| Herpes simplex                        | 905 (1.3)          | 779 (1.2)          | 0.004   |
| Varicella                             | 392 (0.6)          | 315 (0.5)          | 0.006   |
| Verruca vulgaris                      | 1315 (1.9)         | 2209 (3.3)         | <0.001  |

(Continued)

**Table 2** (Continued).

| Diagnoses                         | Pre-Pandemic (N,%) | Post-Pandemic(N,%) | P-value |
|-----------------------------------|--------------------|--------------------|---------|
| Fungal dermatopathy               | 2940 (4.3)         | 2920 (4.3)         | 0.888   |
| Tinea cruris                      | 338 (0.5)          | 346 (0.5)          | 0.657   |
| Pityriasis versicolor             | 427 (0.6)          | 386 (0.6)          | 0.196   |
| Tinea unguium                     | 1283 (1.9)         | 1297 (1.9)         | 0.585   |
| Pityrosporum folliculitis         | 93 (0.1)           | 99 (0.1)           | 0.613   |
| Tinea manuum                      | 68 (0.1)           | 66 (0.1)           | 0.910   |
| Tinea corporis                    | 147 (0.2)          | 159 (0.2)          | 0.436   |
| Tinea capitis                     | 11 (0)             | 6 (0)              | 0.234   |
| Tinea nates                       | 14 (0)             | 8 (0)              | 0.210   |
| Tinea pedis                       | 559 (0.8)          | 553 (0.8)          | 0.995   |
| Other skin infections             | 1647 (2.4)         | 1307 (1.9)         | <0.001  |
| Hair disorders and nail disorders | 1970 (2.9)         | 2418 (3.6)         | <0.001  |
| Alopecia areata                   | 616 (0.9)          | 548 (0.8)          | 0.068   |
| Nail discoloration                | 68 (0.1)           | 55 (0.1)           | 0.265   |
| Paronychia                        | 177 (0.3)          | 220 (0.3)          | 0.023   |
| Onychodystrophy                   | 205 (0.3)          | 207 (0.3)          | 0.838   |
| Premature Gray Hair               | 30 (0)             | 28 (0)             | 0.824   |
| Alopecia                          | 874 (1.3)          | 1360 (2.0)         | <0.001  |
| Neoplasms                         | 1232 (1.8)         | 1455 (2.2)         | <0.001  |
| Keloma                            | 191 (0.3)          | 326 (0.5)          | <0.001  |
| Epidermal cyst                    | 1 (0)              | 1 (0)              | N/A     |
| Syringoma                         | 11 (0)             | 7 (0)              | 0.357   |
| Capillary hemangioma              | 85 (0.1)           | 73 (0.1)           | 0.374   |
| Dermatofibroma                    | 74 (0.1)           | 20 (0)             | <0.001  |
| Callosity                         | 168 (0.2)          | 174 (0.3)          | 0.673   |
| Granulation hyperplasia           | 8 (0)              | 25 (0)             | 0.003   |
| Pigmented nevus                   | 273 (0.4)          | 366 (0.5)          | <0.001  |
| Hemangioma                        | 106 (0.2)          | 92 (0.1)           | 0.356   |
| Granuloma fungoides               | 7 (0)              | 3 (0)              | 0.351   |
| Naevi papillomatosus              | 19 (0)             | 27 (0)             | 0.224   |
| Halo nevus                        | 12 (0)             | 5 (0)              | 0.094   |
| seborrheic keratosis              | 207 (0.3)          | 279 (0.4)          | 0.001   |

(Continued)

**Table 2** (Continued).

| Diagnoses   | Pre-Pandemic (N,%) | Post-Pandemic(N,%) | P-value |
|---|--------------------|--------------------|---------|
| Other undefined benign epithelial tumors and proliferations | 70 (0.1)           | 57 (0.1)           | 0.273   |
| Pigmentary disorders  | 1297 (1.9)         | 1418 (2.1)         | 0.009   |
| Vitiligo  | 770 (1.1)          | 782 (1.2)          | 0.608   |
| Melanism  | 6 (0)              | 1 (0)              | 0.125   |
| Chloasma  | 109 (0.2)          | 182 (0.3)          | <0.001  |
| Lentigo   | 8 (0)              | 21 (0)             | 0.015   |
| Hyperpigmentation   | 158 (0.2)          | 230 (0.3)          | <0.001  |
| Depigmentation  | 246 (0.4)          | 202 (0.3)          | 0.049   |
| Vascular skin disorders                                     | 619 (0.9)          | 714 (1.1)          | 0.005   |
| Behcet's syndrome   | 11 (0)             | 26 (0)             | 0.012   |
| Allergic vasculitis   | 2 (0)              | 1 (0)              | N/A     |
| Allergic purpura  | 172 (0.3)          | 258 (0.4)          | <0.001  |
| Dermatitis contusiformis                                    | 68 (0.1)           | 76 (0.1)           | 0.466   |
| Cutaneous vasculitis  | 20 (0)             | 9 (0)              | 0.044   |
| Pigmented vascular dermatitis                               | 115 (0.2)          | 103 (0.2)          | 0.462   |
| Nodular vasculitis  | 52 (0.1)           | 49 (0.1)           | 0.806   |
| Hemacelinosis   | 179 (0.3)          | 193 (0.3)          | 0.408   |
| Bullous dermatosis  | 21 (0)             | 8 (0)              | 0.017   |
| Pemphigoid  | 1 (0)              | 0 (0)              | N/A     |
| Pemphigus   | 20 (0)             | 8 (0)              | 0.025   |
| Dermal connective tissue diseases                           | 92 (0.1)           | 46 (0.1)           | <0.001  |
| Lupus erythematoses   | 69 (0.1)           | 26 (0)             | <0.001  |
| Pseudotrichinosis   | 7(0)               | 11 (0)             | 0.335   |
| Dermatosclerosis  | 16 (0)             | 9 (0)              | 0.169   |
| Pruritic skin disease                                       | 1259 (1.9)         | 1065 (1.6)         | <0.001  |
| Prurigo nodularis   | 56 (0.1)           | 50 (0.1)           | 0.597   |
| Pruritus  | 242 (0.4)          | 189 (0.3)          | 0.014   |
| Neurodermatitis   | 929 (1.4)          | 799 (1.2)          | 0.003   |
| Prurigo   | 32 (0)             | 27 (0)             | 0.541   |
| Dermatitis medicamentosa and drug rash                      | 120 (0.2)          | 92 (0.1)           | 0.065   |
| Animal-related diseases                                     | 1872(2.8)          | 2100 (3.1)         | <0.001  |
| Insect dermatitis   | 1528 (2.2)         | 1681 (2.5)         | 0.002   |

(Continued)

**Table 2** (Continued).

| Diagnoses                      | Pre-Pandemic (N,%) | Post-Pandemic(N,%) | P-value |
|--------------------------------|--------------------|--------------------|---------|
| Bee sting                      | 57 (0.1)           | 32 (0)             | 0.009   |
| Scabies                        | 175 (0.3)          | 178 (0.3)          | 0.796   |
| Centipede-bite                 | 6 (0)              | 5 (0)              | 0.776   |
| Pediculosis inguinalis         | 85 (0.1)           | 179 (0.3)          | <0.001  |
| Paederus dermatitis            | 21 (0)             | 25 (0)             | 0.532   |
| Urticaria-related diseases     | 5707 (8.4)         | 5138 (7.6)         | <0.001  |
| Dermography                    | 153 (0.2)          | 171 (0.3)          | 0.273   |
| Angioneurotic edema            | 54 (0.1)           | 69 (0.1)           | 0.158   |
| Urticaria                      | 5500 (8.1)         | 4898 (7.3)         | <0.001  |
| Physical dermatitis            | 949 (1.4)          | 806 (1.2)          | 0.001   |
| Pernio                         | 34 (0.1)           | 22 (0)             | 0.118   |
| Sudamen                        | 15 (0)             | 8 (0)              | 0.151   |
| Clavus                         | 429 (0.6)          | 392 (0.6)          | 0.252   |
| Frictional lichenoid eruptions | 181 (0.3)          | 117 (0.2)          | <0.001  |
| Callosity                      | 34 (0.1)           | 63 (0.1)           | 0.003   |
| Solar keratosis                | 0 (0)              | 7 (0)              | 0.008   |
| Solar dermatitis               | 99 (0.1)           | 55 (0.1)           | <0.001  |
| Erythema solare                | 8 (0)              | 7 (0)              | 0.812   |
| Milium                         | 31 (0)             | 35 (0)             | 0.593   |
| Dermatitis aestivale           | 118 (0.2)          | 100 (0.1)          | 0.253   |

**Note:** Data are presented as N (%).

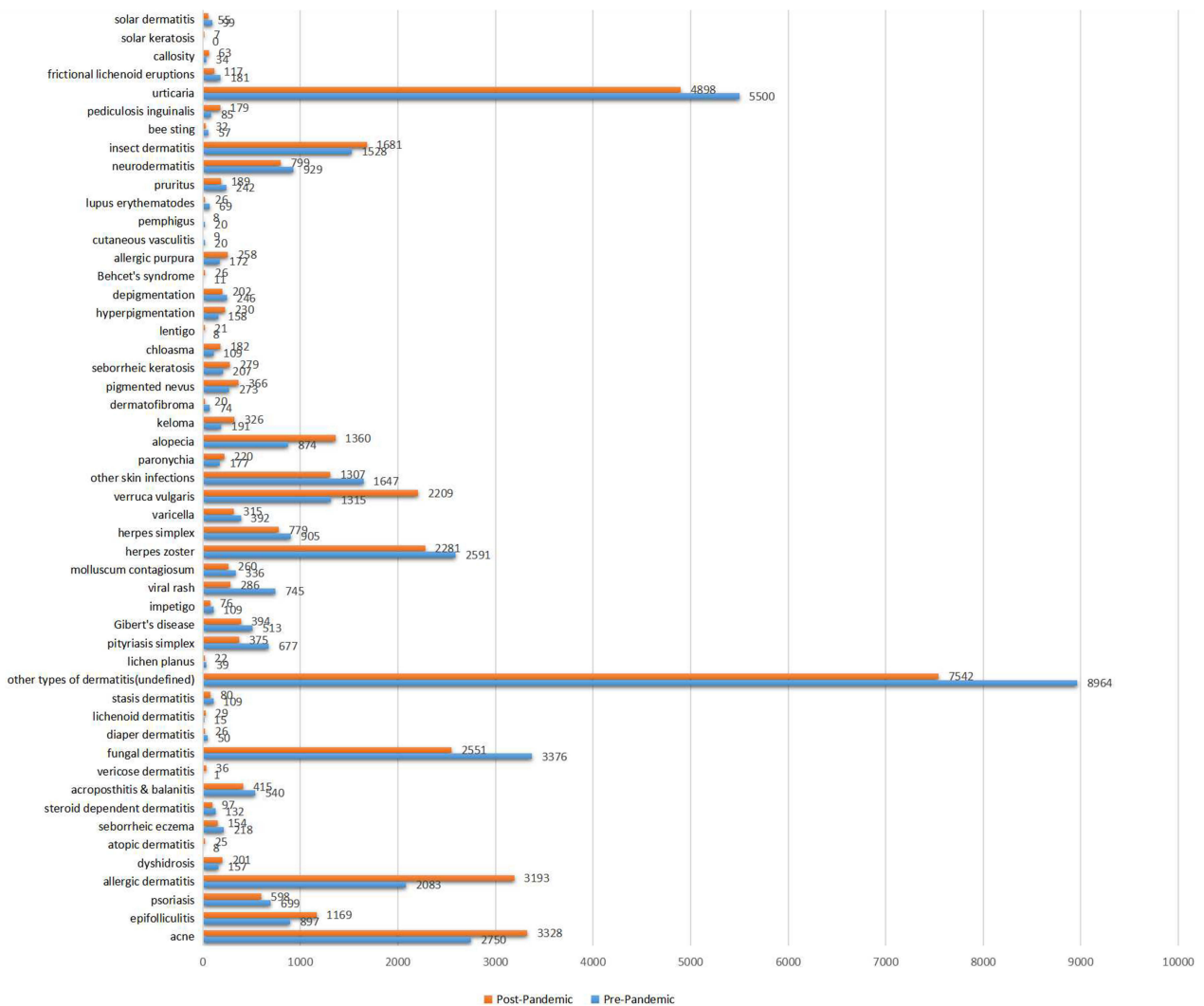
## Discussion

### Principal Findings

With the outbreak of the COVID-19 pandemic, the number of hospital in/outpatient patients and the distribution of diseases diagnoses have changed significantly<sup>14-17</sup> due to national wide lockdown policy: home quarantine, wearing face masks in public places, controlling contact distance and restrictions on activities in public places.<sup>18,19</sup> However, with the COVID-19 pandemic control, people's life gradually returned to normal, Chinese COVID-19 outbreak control has made significant progress in 2021 year, such as the vaccination rate increased significantly, most areas of the people's life returned to normal, can free access, travel (on the basis of the local health department regulation: COVID-19 test negative, COVID-19 vaccination certificate).

Significant reduction of patients visited to the dermatology outpatient department was not observed in the first natural year after effective COVID-19 outbreak control compared to pre-pandemic period. Notably, the age distribution of patients who applied for outpatient department in pre and post the outbreak fluctuated. We found that in the post-pandemic era, the proportion of children (younger than 14 years old) was decreased significantly compared with pre-pandemic visited, but more in adults (14 years or greater than 14 years but younger than 65 years old), the number of outpatient visited for elderly patients (65 years or greater than 65 years old) did not change significantly. This showed that although children's life was normal gradually, but the frequency of went out was less than before the outbreak, further more the school management was more strict than pre-pandemic, such as face masks are required in public places,





**Figure 2** The diagnostic distribution of 51 skin diseases has changed significantly in post-pandemic compared to pre-pandemic. The diagnoses of skin diseases are represented by the vertical lines. The number of diagnoses are represented by the horizontal lines.

reduce crowd gathering, may reduce the incidence of morbidity in children, so for this age, public reduce gathering, can effectively control the occurrence and spread of skin diseases. However, for the elderly, most of them have chronic diseases or non-first visited, and such patients have a high awareness of the risk of the outbreak, so the number of outpatient visited in the elderly population did not change significantly pre and post the pandemic outbreak.

Around COVID-19 pandemic, the sex of patients, who visited to dermatology outpatient department was male-led, but the gradual equilibrium of the male to female ratio suggests a progressive decrease in gender differences in risk perception. Compared with pre-pandemic, in the post-pandemic outpatient patients of dermatology department used the proportion of medical insurance increased significantly, illustrated that the outbreak of the COVID-19 pandemic has changed people’s cognition to disease greatly, in the post-pandemic era, people need to consider the epidemic outbreak at any time or other major events affecting health and normal life, this concern was not so serious before pandemic.

In the post-pandemic era, the diagnostic distribution of some skin diseases has changed significantly (Table 2, Figure 2). We found that before the COVID-19 pandemic outbreak, the most registered diseases among patients attended the dermatology outpatient department were the same as post-pandemic (dermatitis). In such an analysis conducted at the same time, the change of frequency will indicate that after such an unusual period, we can assume that due to age, comorbidity, occupation and other causes of personal risk cognition differences, increased social stress, personal hygiene habits change may change the diagnostic distribution.

In the study, we found a higher percentage of the incidence of acne, and the number of acne diagnosis was increased significantly post-pandemic more than pre-pandemic. Considering the deep psychological impact on people, previous studies have shown that depression, anxiety disorders and physical deformity disorders were higher in acne patients,<sup>20,21</sup> furthermore, psychological disorders such as anxiety and depression were reported due to the outbreak of the COVID-19 pandemic.<sup>22,23</sup> Similarly was alopecia, which increased significantly post-pandemic than pre-pandemic, considering the positive correlation between alopecia and increased stress,<sup>24</sup> indicated that the COVID-19 pandemic outbreak has brought great health and economic pressure to people.

Because after the outbreak of the pandemic, people's lifestyle has changed, including reduced physical activity and increased sedentary time,<sup>25–28</sup> which can increase the incidence of epifolliculitis, allergic dermatitis, allergic purpura, acne and other diseases. Although insect bite dermatitis increased post-pandemic than pre-pandemic, the absolute increase was not large, and climate, weather and other reasons could not be ruled out. Some studies have confirmed the relationship between warts and stress,<sup>29,30</sup> so the diagnosis of verruca vulgaris has increased significantly in post-pandemic compared to pre-pandemic, which was related to stress from pandemic. The study found that the number of some diagnoses was increased in post-pandemic than pre-pandemic, as below: dyshidrosis, atopic dermatitis, varicose dermatitis, lichenoid dermatitis, paronychia, keloma, pigmented nevus, seborrheic keratosis, chloasma, lentigo, hyperpigmentation, Behcet's syndrome, pediculosis inguinalis, etc., but the number of these diagnoses was small, with outpatient doctors do not need special response or interventional procedure.

From the results of the study, the diagnosis of fungal dermatitis, pityriasis simplex, herpes zoster, viral rash, herpes simplex, physical dermatitis, Gibert's disease, seborrheic eczema and other diseases in post-pandemic was significantly reduced than in pre-pandemic. These diseases without increased frequency can be explained by one or more of the following reasons, due to reduced outdoor activities, social activity restrictions, population reduced risk of infection, so some viral infections, contact infections, physical dermatitis and other factors significantly reduced. However, we found in some studies that herpes infections increased during the pandemic, which virus participated process possibly, and in our study all patients were not infected with the virus, only because the lifestyle changed.<sup>34</sup>

Although the itching skin disease will be affected by mood, depression and stress, but the study found that urticaria diagnosis was reduced in post-pandemic compared to pre-pandemic, the major reason was considered the classification of urticaria with complex and diversity, which including spontaneous, inducible and contact,<sup>31</sup> may receive the influence of the above factors to increase, or may also be reduced by isolation policy. In addition, these diagnoses with reduced frequency also need to consider the improvement of the treatment level and prevention level of the skin disease, which reduces the incidence of diseases, of course, it cannot be ruled out that the hospital phobia caused by the epidemic affects the willingness of some patients to come to the hospital. With the development of COVID-19 vaccine, more and more people are being vaccinated with COVID-19 vaccine. Recent studies have reported the impact of vaccine on skin diseases, fortunately, these reactions are commonly short, benign and self-limited.<sup>35</sup>

Although there are still some mysteries about the impact of COVID-19 on skin diseases, such as different subtypes of the virus and different types of vaccines, we still expect more studies to solve the current mysteries in the future.<sup>36</sup>

## Strengths, Limitations and Future Directions

Our study was uniquely and valuably, which aims to understand what changed the pandemic outbreak had brought to the dermatology outpatient department, and understand the trends and effects of skin diseases on patients and health systems during this pandemic outbreak will help to better prepare dermatologists in the future. At the same time, the research results are also of certain reference significance for the treatment of skin diseases in the post-epidemic era.<sup>37</sup> On the other hand, the study was the pre-/post-comparative research, by analyse the demographic characteristics and the characteristics of the distribution of disease diagnosis in dermatology outpatient department between the two periods (2019 year and 2021 year), was not included data in the pandemic outbreak time, because the medical system had changed tremendous in the outbreak times, most of the outpatient could not work and live normally. Therefore, in 2021, after the pandemic outbreak was effectively controlled, it could be compared as post-pandemic times with pre-pandemic times.

The study has some limitations. As the study was retrospective, we did not include detailed data on the clinical examination (blood tests, instrument examination), quality of life, anxiety level and treatment method. Furthermore, this study was a single

center study and may have under-representation. The study was located in the most economically developed regions in China, and the study results did not represent the current situation of some underdeveloped regions. The study lacked the impact of the COVID-19 pandemic on health-care workers, such as frequent hand washing times and increased wearing of masks and gloves, which also induce some related skin diseases.<sup>32,33</sup> Finally, the skin diseases are very complex disease systems, especially for diagnosis, and many diagnoses may combine with many other diseases, so there may be some bias in the study results.

From the results, it was not difficult to see that the distribution of many skin diseases changed significantly due to the impact of the COVID-19 pandemic, and clinicians, medical managers and health service departments should make timely adjustments and necessary interventions to avoid the medical negligence. If because of the pandemic outbreak, increased the people's pressure, fear, depression, etc., whether they can consider the necessary psychological intervention and treatment, if because of pandemic prevention policy can reduce the occurrence of some skin diseases, so can learn experience, can try to prolong times of take mask or avoid gathering.

## Conclusion

The COVID-19 pandemic had a minimal effect on the average yearly dermatology outpatients department visits, but the distribution of dermatology diagnoses was affected. During the post-pandemic period, the diagnoses: acne, animal-related diseases, allergic dermatitis, insect dermatitis, alopecia, and verruca vulgaris were found to increase statistically when compared with the pre-pandemic period. As a result, governments and health departments may introduce innovative ways and training of medical teams according to the impact of the pandemic to ensure normal medical care, specially to relieve pressure and psychological counseling as soon as possible, and how to better adapt to the lifestyle changed due to the COVID-19 pandemic, so as to reduce the occurrence of skin diseases and improve the quality of people's life.

## Ethics Approval Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of the Affiliated Taicang Hospital of Soochow University (KY-2022-156). The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

## Author Contributions

All authors made a significant contribution to the work reported, whether that was in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

## Disclosure

The authors report no conflicts of interest in this work.

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