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Changing trends in oral mucosal diseases in China (2016–2024): a cross-sectional study of 316,166 patients with focus on COVID-19 impact and use of chinese patent medicines

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Abstract

Background Oral mucosal health is a critical component of overall oral health and impacts an individual's quality of life. Despite variations in prevalence rates of oral mucosal diseases across regions, previous studies often involved small sample sizes with insufficient data analysis. This study addresses the gap by providing a comprehensive analysis of the changing spectrum of oral mucosal diseases in China, with a focus on the impact of COVID-19. It also explores trends in the use of Chinese patent medicines (CPMs) for treatment.

Methods This retrospective, cross-sectional study included 316,166 patients from the Department of Oral Medicine at Peking University School and Hospital of Stomatology between 2016 and 2024. Data on patient demographics, chief complaints, diagnoses, and the use of CPMs were collected and analyzed. Statistical comparisons were made using *t*-tests and chi-square tests, with significance set at $P < 0.05$.

Results The average patient age was 49.42 ± 17.92 years, and women were significantly overrepresented (male/female ratio: 0.59). The most frequent diagnoses were oral lichen planus and recurrent aphthous stomatitis, accounting for the top two positions each year. The study found significant differences in disease patterns among age groups, with oral potentially malignant disorders like oral lichen planus becoming more prevalent in older populations. CPMs were used by 52.29% of patients, with similar proportions using topical and systemic treatments. During the COVID-19 pandemic (2020–2022), the number of patients dropped significantly, and an increased prevalence of burning mouth syndrome and oral candidiasis was observed.

Conclusion This study offers the largest amount of valuable epidemiological data on the management of oral mucosal diseases to date in China, underscoring the need for targeted health resource allocation. An important trend was the greater predilection for females and middle-aged and elderly populations. The top three diseases in terms of number of patients were oral lichen planus, recurrent aphthous stomatitis, and oral candidiasis. The treatment

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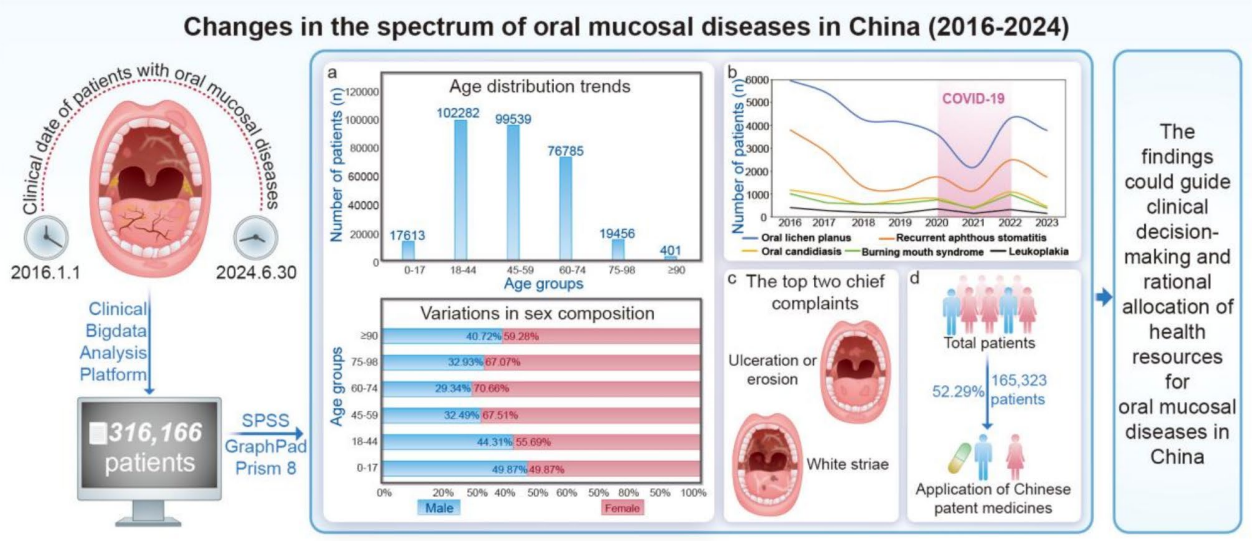
data indicated widespread use of CPMs for oral mucosal diseases. The COVID-19 pandemic was associated with a significant decrease in the number of total patients and was also characterized by an increase in the proportion of patients with diseases that have psychosomatic associations. The impact of the COVID-19 pandemic and the widespread use of CPMs warrant further investigation in future studies to ensure evidence-based medical practices.

Clinical trial number Not applicable.



Keywords Oral mucosal disease, Spectrum, China, Oral diseases, Chinese patent medicines, COVID-19

Introduction

Oral mucosa health is one of the key components of oral health, which is an important factor that affects an individual's quality of life. Oral mucosal diseases encompass a range of conditions involving the oral mucosa, including benign conditions, oral infections, immunologically mediated conditions, potentially malignant disorders, and oral cancers, and affect populations of all ages [1–3]. The reported prevalence of oral mucosal disease in the general population across different regions and countries ranges widely from 4.9 to 81.3%, and the reported proportions of specific oral mucosal diseases in different studies also vary greatly [4–8]. However, the sample sizes of these studies are generally small, and their analysis of the data is often insufficient. Moreover, there is a lack of studies on the entire spectrum of oral mucosal diseases, particularly in terms of epidemiological and clinical data analyses on the prevalence, diagnosis, and treatment status, as well as the changes in the spectrum of oral mucosal diseases.

The spectrum of oral mucosal diseases in the Chinese population has changed significantly over the past decades as a result of economic and social development, aging of the population, changes in lifestyle, and the impact of the COVID-19 epidemic. The study of the disease spectrum could guide the rational allocation of medical resources through their prioritization for the treatment and prevention of highly prevalent and serious diseases in a particular population. Hospital data can serve as an important reference for determining the prevalence and characteristics of diseases, and analyzing changes in the data may help shed light on the entire oral mucosal disease spectrum in this population.

Accordingly, this retrospective study tries to fill in the gap in the literature by using hospital data collected from the Department of Oral Medicine, Peking University School and Hospital of Stomatology. The center has been providing services for the prevention, diagnosis, and treatment of oral mucosal diseases to patients across China since the 1940s through a combination of Chinese and Western medicine. Traditional Chinese medicines (TCMs) have a history of over 2000 years in China. They are typically not indicated for the treatment of acute illnesses, but are highly suitable for the management of non-serious chronic diseases [9]. Since a significant number of oral mucosal diseases have a long duration, treatment with TCMs or adjunctive treatment with TCMs could be effective. Chinese patent medicines (CPMs) are modern pharmaceutical preparations in the form of granules, capsules, and pills, mainly made according to standardized formulas of Chinese herbal medicines, and are an important part of TCMs.

The main aim of the present study was to explore the changing spectrum of oral mucosal diseases in China and also determine the impact of the COVID-19 epidemic on these trends. In addition to this, the demographic characteristics and changes in the main diagnoses and treatment measures for patients with oral mucosal diseases were analyzed. Further, we explored the trends in the use of CPMs for oral mucosal diseases.

Methods

Ethical approval

This study received the approval of the Institutional Review Board (IRB) of the Peking University School and Hospital of Stomatology (approval no. PKUSSIRB-202277081). Written informed consent was waived because all personal identifiable information was removed from the dataset prior to analysis.

Study design and population

This retrospective cross-sectional, single-center study included patients with oral mucosal diseases who visited the Department of Oral Medicine, Peking University School and Hospital of Stomatology, between January 1, 2016, and June 30, 2024. and followed the STROBE Statement for reporting. Patients who had only basic information and incomplete medical records with missing key diagnostic information, such as those who withdrew or canceled their appointments, were excluded.

Data collection

The following sets of data were collected using the software of the Clinical Bigdata Analysis Platform from the Information Center.

Annual patients and general demographic characteristics

General demographic information, including data for sex and age, was collected by reviewing the clinical records of the patients who visited over the study period. the total number of patients and the annual patient numbers from 2016 to 2024 were calculated, and the patients were categorized into age groups according to the age segmentation criteria recommended by the World Health Organization (WHO).

Chief complaints and diagnoses

Data on the patients' chief complaints that prompted the visit and data on the diagnoses were extracted. The diagnosed diseases were determined by referring to the eleventh revision of the International Classification of Diseases (ICD-11) [10]. The top ten complaints and diagnosed diseases were recorded and analyzed.

Application of Chinese patent medicines

Patients who were treated with CPMs were selected by searching for those who received the following medicines: *Taixianping* Granules, *Huoxue Shengjin* Granules, *Kouyanqing* Granules, *Ziyin Qingre* Granules, *Kouyankang* Granules, *FangFeng TongSheng* Pills, *Shuanghua Baihe* Tablets, Oral Ulcer Powder, *Kangfuxin* Solution, and *Xipayi* Mouth Rinse. The information on the key ingredients and manufacturers of the CPMs was shown in detail in the Supplementary Table. The number and proportion of patients treated with topical and/or systemic CPMs were determined.

Statistical analysis

Statistical analysis was performed using SPSS statistical software (SPSS, Chicago, IL) and GraphPad Prism 8 (GraphPad Software). Continuous variables are presented as mean (± standard deviation), and categorical variables are presented as numbers and proportions. Two-sample means were compared using a *t*-test, and the proportions were compared by the chi square-test. $P < 0.05$ was considered to indicate statistical significance.

Results

Age, sex, and chief complaints distribution

A total of 316,166 patients were included in this study. The mean age of all patients was 49.42 ± 17.92 years, and the number of women was significantly higher than that of men (male/female ratio: 0.59). The mean age and sex distribution of the patients by year were not significantly different from those of the overall patients ($P < 0.05$), and the mean age by year ranged from 48.53 ± 18.89 years to 49.89 ± 17.85 years (Table 1).

Regarding age trends, the highest number of patients were in the age groups 18–44 years and 45–59 years, followed by 60–74 years, with these groups accounting for 88.12% of the total patients, while the remaining age groups accounted for 11.88% of the visits (Fig. 1A).

With regard to the sex composition of age groups, we found that the proportion of women was higher in all age groups (consistent with the trend observed for the total patients). This suggests that women were more vulnerable to oral mucosal diseases in all age categories. This predilection for females was more prominent in the age groups 60–74 and 45–59 years (Fig. 1B).

The most common chief complaints were ulceration or erosion, white striae, irritation and pain, and lip crusting and rhagades, which together accounted for 19.19% of the total chief complaints (Table 2).

Distribution of the diagnoses of oral mucosal diseases

The top 10 diagnosed oral mucosal diseases among the total patients were analyzed and compared by year. The results showed that the top two diagnosed diseases

Table 1 Characteristics of the included patients by year (2016–2024)

Characteristics	Total	2016	2017	2018	2019	2020	2021	2022	2023	2024
Number of patients, n	316,166	47,148	44,709	42,871	43,090	23,898	36,717	26,924	34,048	16,761
Age, mean ± SD (years)	49.42 ± 17.92	49.48 ± 17.82	49.45 ± 17.86	49.67 ± 17.63	49.84 ± 17.84	49.89 ± 17.85	48.63 ± 18.33	48.53 ± 18.89	49.54 ± 17.25	49.70 ± 17.86
Sex, n (%)										
Male	117,551 (37.18)	17,209 (36.5)	16,793 (37.56)	16,222 (37.84)	15,857 (36.80)	8,914 (37.3)	13,699 (37.31)	9,881 (36.70)	12,778 (37.53)	6,198 (36.98)
Female	198,615 (62.82)	29,939 (63.5)	27,916 (62.44)	26,649 (62.16)	27,233 (63.2)	14,984 (62.7)	23,018 (62.69)	17,043 (63.30)	21,270 (62.47)	10,563 (63.02)

#Data for 2024 were obtained up to June 30, 2024

remained the same in ranking across all years, which were oral lichen planus and recurrent aphthous stomatitis, both overall and by year, but there were slight variations in the proportion of the top 10 diagnosed diseases over the years (Fig. 2).

The top 10 diagnosed oral mucosal diseases were recorded separately for each age group, and the results revealed significant differences in the composition of the major diagnosed diseases among the age groups. Among the top 10 diagnosed diseases in the 0–17 years group, only one potentially malignant disease was included, which was oral lichen planus, and it ranked fourth, while the top three diseases were recurrent aphthous stomatitis, traumatic lesions, and cheilitis. In contrast, burning mouth syndrome was among the top ten diseases in the 18–44 and 45–59 years groups, ranked in the fourth and third place, respectively. In the 45–59, 60–74, and 75–89 years age groups, oral potentially malignant disorders, including oral lichen planus, leukoplakia, chronic discoid lupus erythematosus, and oral lichenoid reaction, accounted for four of the top 10 diagnosed diseases. In addition to this, the proportion of patients with oral candidiasis appeared to increase with age: it ranked seventh in the 0–17 years age group and moved up to the first rank in the ≥ 90 years age group (Table 3).

Application of CPMs

The number and proportion of patients treated with topical and/or systemic CPMs were analyzed. Of the total patients, 165,323 (52.29%) receive treatment with CPMs, indicating a high application rate. Among these, 75,470 patients were treated with topical medications, and 74,478 with systemic medications, and 15,375 received both topical and systemic CPMs.

Impact of the COVID-19 epidemic

The average annual number of patients over the three-year period of the COVID-19 pandemic (2020 to 2022) was significantly lower than that for the four years preceding and the one year following the pandemic, that is, 2016–2019 and 2023, respectively (Table 4). Comparison of disease composition between the 2016–2019, 2023 and 2020–2022 showed a significant increase in the proportion of patients with burning mouth syndrome and oral candidiasis and a decrease in the proportion of patients with oral lichen planus, recurrent aphthous stomatitis, as well as pemphigus and pemphigoid (Table 4).

Discussion

This study provides insights into the spectrum of oral mucosal diseases in China by analyzing data gathered from 316,166 patient visits to the Department of Oral Medicine at our center. This study integrated the largest

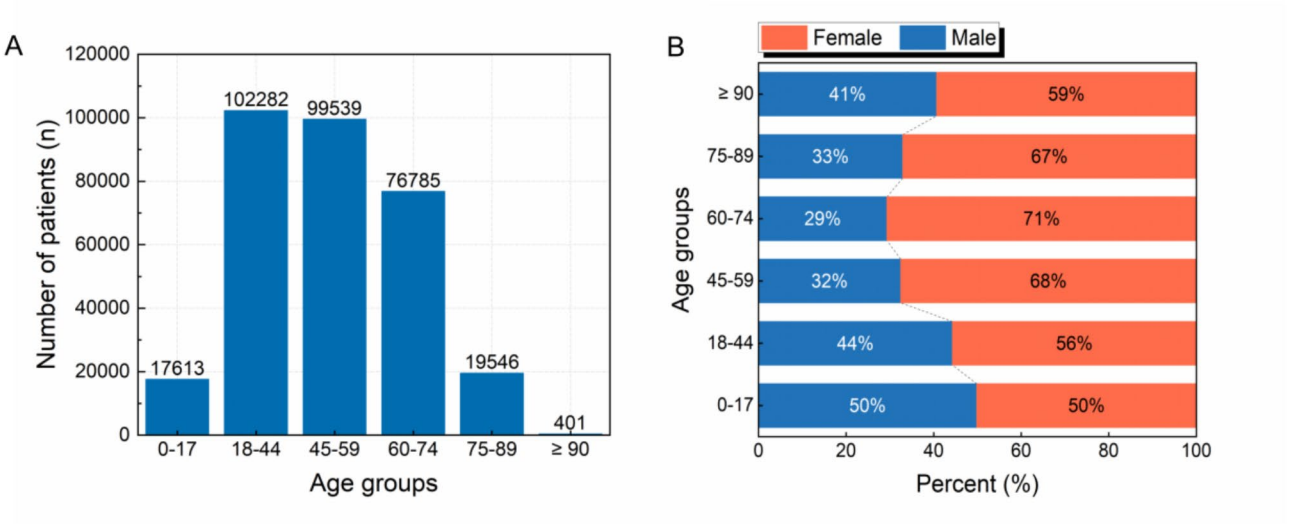


Fig. 1 Demographic trends of oral mucosal disease patients by age and sex. (**A**) Age distribution trends for the total patients. (**B**) Variations in sex composition according to age groups

Table 2 Distribution of the top ten chief complaints

Rank	Total (2016–2024)		
	Chief complaints	**Number**	**Proportion (%)**
1	Ulceration or erosion	31,594	9.99%
2	White striae	14,056	4.45%
3	Irritation and pain	9,322	2.95%
4	Lip crusting and rhagades	5,678	1.80%
5	Dry mouth	5,313	1.68%
6	Burning sensation	3,668	1.16%
7	Mass and swelling	2,433	0.77%
8	Blistering	2,386	0.75%
9	Redness	1,823	0.58%
10	White plaque	1,626	0.51%

amount of data on the management of oral mucosal diseases to date, making the findings representative.

Overall, the results showed no dramatic changes in the top 10 oral mucosal diseases from the year 2016 to 2024, although there were slight differences in their ranking. Among them, oral lichen planus and recurrent aphthous stomatitis consistently ranked as the top two reasons for patient visits in each of the years examined. Consistent with this disease ranking, the top two chief complaints were ulceration/erosion and white striae, which are known signs of oral lichen planus and recurrent aphthous stomatitis. Consistent with the results of the present study, the findings of single-center studies conducted in Gansu Province, Shenzhen, Shandong Province, and Henan Province, China, all identified oral lichen planus and recurrent aphthous stomatitis as the most common oral mucosal diseases [11–14]. However, in several single-center studies conducted in Hunan Province, China, oral submucosal fibrosis ranked higher in patients with oral mucosal diseases, and even ranked first in males. This local characteristic may be related to the high production and consumption of betel nut in this region [15, 16].

The present study also examined the age- and sex-related trends in the spectrum of oral mucosal diseases and found that they were generally more prevalent in the middle-aged and elderly age groups and in females. Specifically, when the patients were grouped according to WHO age categories, the age group 18–44 years accounted for the highest number of patients. This could be explained by the larger age range captured by the 18–44 age group. Further subgroup refinement is likely to lead to findings that are more in line with the mean age. Our results were consistent with the age and sex distribution reported in other studies [11–14, 16]. The possible reason for the female predilection for oral mucosal diseases is that the present study demonstrated that oral lichen planus and recurrent aphthous stomatitis are the most common oral mucosal diseases, both of which are characterized by a high prevalence among females. Further, in our findings, we observed a greater predilection for females in the 45–59 and 60–74 age groups. Thus, in the Chinese population examined here, the predilection for females appears to increase with age.

The current findings also show a significant variability in disease spectrum between age groups. In the 0–18 age group, the top three diseases are all benign diseases. In the young and middle-aged population, lichen planus, a potentially malignant disease, accounted for the highest number of patients. Further, burning mouth syndrome, which is highly associated with anxiety and depression, ranked among the top three diseases in the middle-aged population. In the elderly population, oral candidiasis ranked among the top three diseases, and it

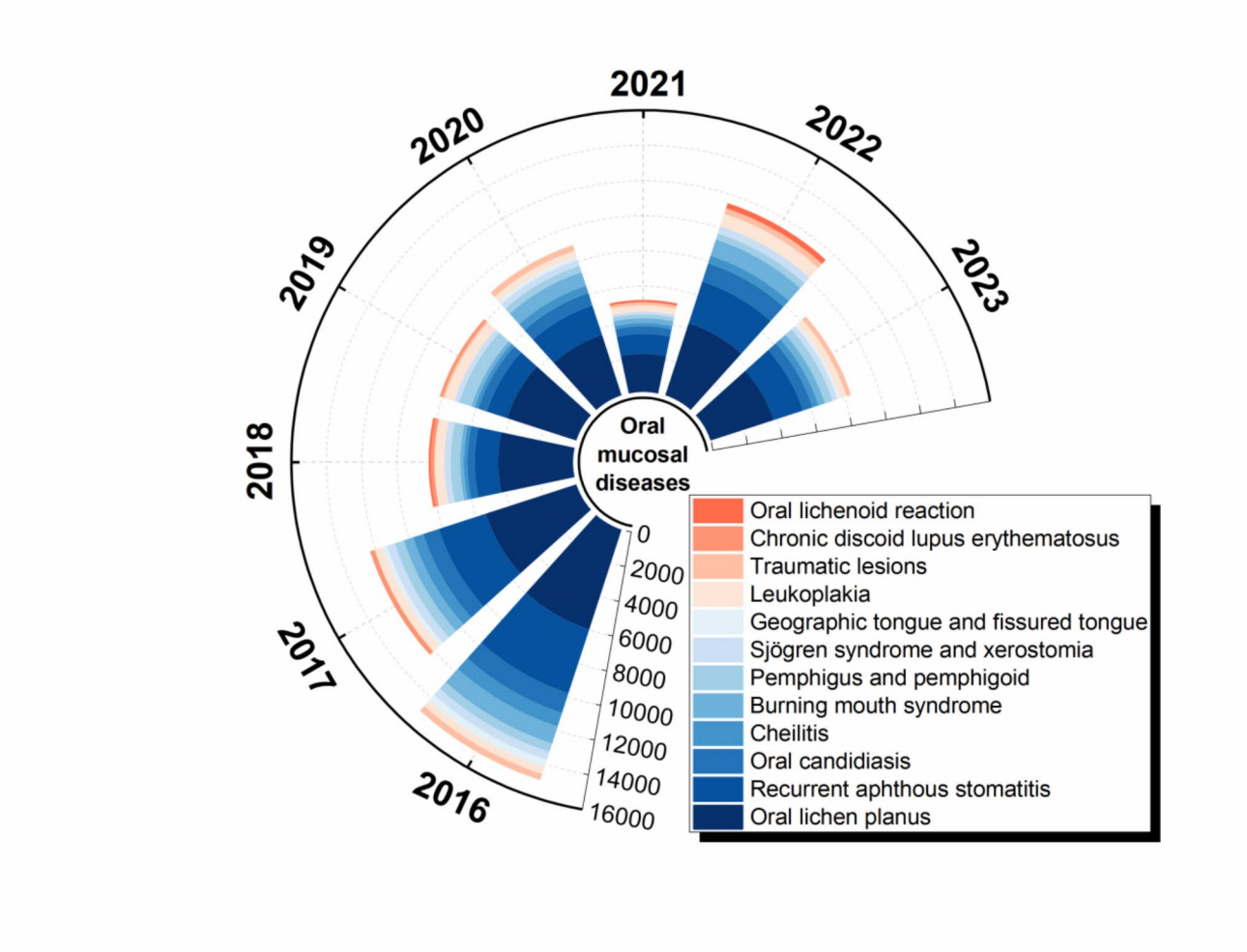


Fig. 2 Distribution of the top ten oral mucosal diseases from 2016 to 2023

Table 3 Top ten oral mucosal diseases across different age groups

Rank	Age groups (years)					
	0–17	**18–44**	**45–59**	**60–74**	**75–89**	**≥90**
1	RAS	OLP	OLP	OLP	OLP	OC
2	Trauma	RAS	RAS	RAS	OC	OLP
3	Cheilitis	Cheilitis	BMS	OC	RAS	RAS
4	OLP	BMS	OC	BMS	OLK	Trauma
5	GT / FT	OLK	P / PEM	OLK	Trauma	BMS
6	HGS	P / PEM	OLK	P / PEM	SS / Xer	OLK
7	OC	OC	SS / Xer	SS / Xer	BMS	cDLE
8	GC	GT / FT	cDLE	cDLE	P / PEM	Anemia
9	EM	Allergy	OLR	Trauma	cDLE	SS / Xer
10	WSN	OSF	GT / FT	OLR	OLR	Leuko

Notes: RAS: Recurrent aphthous stomatitis; Trauma: Traumatic lesions; OLP: Oral lichen planus; BMS: Burning mouth syndrome; GT / FT: Geographic tongue and fissured tongue; OLK: Leukoplakia; HGS: Herpetic gingivostomatitis; P / Pem: Pemphigus and Pemphigoid; SS / Xer: Sjögren syndrome and xerostomia; OC: Oral candidiasis; cDLE: Chronic discoid lupus erythematosus; Anemia: Anemic stomatitis; Allergy: Allergic stomatitis; GC: Granulomatous cheilitis; EM: Erythema multiforme; OLR: Oral lichenoid reaction; WSN: White sponge nevus; OSF: Oral submucosal fibrosis; Leuko: Leucokeratosis

ranked higher with the increasing age of the age groups. In addition, the results of the disease spectrum analysis by age group also showed that the top three diseases in the 60–74 age group were oral lichen planus, recurrent aphthous stomatitis, and oral candidiasis, while they were oral lichen planus, recurrent aphthous stomatitis, and burning mouth syndrome in the 45–59 age group. Lichen planus, recurrent aphthous stomatitis, and

Table 4 Impact of the COVID-19 pandemic on the spectrum of oral mucosal diseases

	Pre-pandemic and post-pandemic years (2016–2019, 2023)	Pandemic years (2020–2022)	*P*-value
Average number of patients per year (n)	42,373	29,180	-
Number and proportion of primary diagnoses, n (%)			
Oral lichen planus	23,559 (11.12%)	8,334 (9.52%)	0.000*
Recurrent aphthous stomatitis	10,868 (5.13%)	4,167(4.76%)	0.000*
Oral candidiasis	3,644 (1.72%)	1,707 (1.95%)	0.000*
Burning mouth syndrome	2,373 (1.12%)	1,576 (1.80%)	0.000*
Leukoplakia	2,394 (1.13%)	1,024 (1.17%)	0.127
Pemphigus and pemphigoid	2,775 (1.31%)	858 (0.98%)	0.000*
Cheilitis	2,182 (1.03%)	910 (1.04%)	0.866
Sjögren syndrome and xerostomia	1,886 (0.89%)	718 (0.82%)	0.142

*$P < 0.05$

burning mouth syndrome have all been found to have a predilection for females [17–20]. This trend along with the larger proportions of females found in these two age groups may explain the predominance of the three diseases in the two age groups.

As China has a long-standing tradition of using herbal remedies for a wide range of ailments, another topic explored in the present study was the use of CPMs in the treatment of oral mucosal diseases. The results showed that more than half of the patients were treated with CPMs, with the use of topical and systemic medications being similar. Accordingly, meta-analyses by Li et al., Zhou et al., and Shavakhi et al. have indicated that topical and systemic treatment with TCMs may be beneficial in patients with recurrent aphthous stomatitis by reducing ulcer size and frequency, shortening ulcer duration, and relieving pain without severe side effects [21–23]. Furthermore, in patients with pemphigus, CPMs could act as an alternative to corticosteroids and may be beneficial as adjuvant treatment in terms of lesion healing and prevention of complications and relapse [24]. Moreover, CPMs might be effective for the prevention and treatment of radiotherapy and chemotherapy-induced oral mucositis, and TCMs could have potential as cost-effective and less toxic alternatives or as complementary options to commonly prescribed corticosteroids in the treatment of oral lichen planus [25, 26]. Despite these promising findings, the widespread application of CPMs is dabated due to the poor quality of the reported research. Therefore, given the high rate of use of these CPMs for oral mucosal diseases observed in this study, more well-designed randomized controlled studies and real-world studies are still needed to bridge the gap between TCM and evidence-based medicine.

Our final area of investigation was the impact of COVID-19 on patients for the spectrum of oral mucosal diseases. We observed a higher prevalence of burning mouth syndrome, which is known to have psychosomatic associations. This may be explained by the significantly higher prevalence of anxiety, insomnia, and somatic symptoms in the population during the COVID-19 epidemic [27]. The reduction in the number of patients in 2020 and 2022 could be related to the mask mandates and decreased social activities, which may have effectively reduced the outbreaks of infectious diseases such as herpes simplex and herpes zoster.

When comparing our findings with those from other countries, several notable trends emerge. Similar to our results in China, studies from the United States, Brazil, Chile, and Sweden also report a higher prevalence of oral mucosal diseases in older populations, which aligns with the findings of systematic review [28–30]. Additionally, oral candidiasis is commonly observed in the elderly population globally [6, 7, 28, 31]. However, there are still differences between studies in terms of sex predispositions [32–34]. This may be due to variations in the populations studied and the diseases they focused on. The populations involved in these studies vary, including both community populations and outpatients. Furthermore, studies showing a male predisposition to oral mucosal diseases often focus on conditions related to smoking, such as oral leukoplakia. Notably, the use of CPMs in the treatment of oral mucosal diseases has not been explored internationally, leaving their specific role and application largely under-researched outside of China. This makes our study a pioneering effort in this area. Lastly, the impact of the COVID-19 pandemic on oral health, particularly in terms of an increase in psychosomatic-associated conditions, is a shared experience across nations, suggesting global shifts in psychological well-being during COVID-19 pandemic [35]. Future research should continue to explore these cross-national differences to better inform global clinical practices and health policies.

One of the main limitations of this study is its cross-sectional design and the lack of a risk factor analysis, as a result of which we were unable to understand the causes underlying the occurrence of the oral mucosal diseases. The design of single-center study may limit the

representativeness of the results, and potential inconsistencies in the assessment criteria used by different physicians in the retrospective study could introduce bias. Furthermore, the treatment effects and disease progression were not analyzed either. We aim to address these limitations through more prospective studies in the future.

Conclusion

The data analyzed here from 316,166 patients of the Department of Oral Medicine, Peking University School and Hospital of Stomatology revealed distinct patterns in the spectrum of oral mucosal diseases. An important trend was the greater predilection for females, as well as for middle-aged and elderly populations. The top three diseases in terms of number of patients were oral lichen planus, recurrent aphthous stomatitis, and oral candidiasis. The treatment-related data showed that CPMs were widely used in the treatment of oral mucosal diseases. The COVID-19 pandemic was associated with a significant decrease in the number of total patients and was also characterized by an increase in the proportion of patients with diseases that have psychosomatic associations. Overall, this study provides a scientific basis for clinical decision-making and rational allocation of health resources for oral mucosal diseases in China. The impact of the COVID-19 pandemic and the widespread use of CPMs require further investigation in future studies to ensure evidence-based medical practices.

Abbreviations

TCMs	Traditional Chinese medicines
CPMs	Chinese patent medicines
WHO	World health organization
ICD	International classification of diseases
RAS	Recurrent aphthous stomatitis
Trauma	Traumatic lesions
OLP	Oral lichen planus
BMS	Burning mouth syndrome
GT / FT	Geographic tongue and fissured tongue
OLK	Leukoplakia
HGS	Herpetic gingivostomatitis
P / Pem	Pemphigus and Pemphigoid
SS / Xer	Sjögren syndrome and xerostomia
OC	Oral candidiasis
cDLE	Chronic discoid lupus erythematosus
Anemia	Anemic stomatitis
Allergy	Allergic stomatitis
GC	Granulomatous cheilitis
EM	Erythema multiforme
OLR	Oral lichenoid reaction
WSN	White sponge nevus
OSF	Oral submucosal fibrosis
Leuko	Leucokeratosis

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-05797-7.

Supplementary Material 1: **Supplementary Table**

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Author contributions

P.Z. and X.Z. wrote the main manuscript text. Y.C. and J.F. contributed to data analysis and interpretation. Y.M. and F.Y. provided critical revisions and scientific input. P.W. and H.H. supervised the study and reviewed the manuscript. All authors reviewed and approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of the Peking University School and Hospital of Stomatology (Approval no. PKUSSIRB-202277081). Written informed consent was waived by the IRB of the Peking University School and Hospital of Stomatology as all personal identifiable information was removed from the dataset prior to analysis. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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