



Article

Prevalence of Oral Lesions and Their Association with Systematic Diseases Among Children

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Abstract: Background: Pediatric oral lesions vary by developmental stage and sex, yet their distribution remains insufficiently characterized in young clinical populations worldwide. Aims of the study: This study aimed to characterize oral lesion patterns and examine their distribution according to age and sex among children. Methodology: This descriptive cross-sectional study included 14 children who underwent clinical oral examination at Azadi Teaching Hospital between January 3, 2026, and October 10, 2026. Children with complete demographic and diagnostic records were eligible, while incomplete or duplicated records were excluded. A trained clinician examined participants under adequate illumination using sterile instruments. Lesions were evaluated according to clinical appearance, anatomical location, and presenting features, then classified as oral candidiasis, aphthous ulcers, or viral oral infection. Age was analyzed continuously and categorized as <1, 1–<2, 2–<3, and ≥3 years. Result: The study included 14 children (mean age, 1.55±1.01 years), of whom 64.3% were female. Oral candidiasis was the predominant lesion, accounting for 71.4% of cases, whereas aphthous ulcers and viral infections each represented 14.3%. Candidiasis occurred in 66.7% of females and 80.0% of males. Lesion distribution did not differ significantly by sex ($P=0.760$) or age ($P=0.210$). Candidiasis was particularly frequent among children younger than two years, although subgroup estimates were limited by the small sample size and wide confidence intervals. Conclusions: Oral candidiasis predominated, particularly among children younger than two years. Lesion patterns were not significantly associated with age or sex. Larger population-based studies incorporating healthy controls, microbiological confirmation, and systemic clinical factors are needed to validate these preliminary findings.

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1. Introduction

During childhood, oral health influences and is closely connected to nutrition, communication, physical growth and development, social skills and well-being. Oral mucosal lesions are a diverse group of abnormalities that involve the lips, tongue, gingiva, palate, buccal mucosa and floor of the mouth. These encompass infectious, aphthous, traumatic, inflammatory, immune mediated, and developmental lesions, and oral disease secondary to systemic disease. Epidemiology of pediatric oral mucosal diseases has been less well-studied than other oral diseases, such as dental caries and periodontal diseases. Some population-based studies conducted in China had reported an intraoral soft-tissue prevalence rate of around 1.8% [1] while a recent study among schoolchildren from Ecuador revealed a significantly higher rate of intraoral soft-tissue findings [2]. This difference could be due to differences in population age structure, geographic location,

sampling technique, diagnostic criteria, training of examiners, and clinical characteristics of the populations studied.

The clinical diagnosis of oral lesions in children may be difficult due to similar appearance of irrelevant lesions. Localized traumatic or infectious causes can lead to ulceration, erythema, vesicles, white plaques, mucosal atrophy and enlargement of gums but may also be a feature of malnutrition, haematological disorders, gastrointestinal disorders, endocrine disorders, autoimmune disorders, or neoplastic diseases. Oral and maxillofacial abnormalities do sometimes precede typical systemic signs and symptoms and appropriate medical referral can be made as early as possible through careful oral examination [3]. However, most oral lesions do not have a particular disease association and interpretation should take into account age, location, duration of lesion, recurrence, pain, medication history, nutritional status, immune function and other systemic symptoms.

There are also significant physiological changes in the oral cavity from infancy to adolescence. The oral microbiome structure and function is impacted by tooth eruption, diet transitions, maturation of the salivary glands, hormonal shifts, exposure to antimicrobials, and oral hygiene. Dysbiosis of the microflora can allow the growth of opportunistic microorganisms and lead to inflammation of the mucous membranes, as well as the development of oral candidiasis, dental caries and periodontal disease [4]. Immune maturation could also be responsible for the age-related changes that occur in the prevalence of candidiasis and some viral infections in infants and the increased likelihood of these immune-mediated lesions in older children.

Oral candidiasis is a fungal disease which is an opportunist infection and is primarily caused by *Candida albicans*. It usually manifests itself as white plaques, exposed reddened mucosa, angular cheilitis, or as a problem with feeding. It can be induced by a number of factors, including infancy, exposure to antibiotics, inhaled corticosteroids, malnutrition, diabetes, immunodeficiency, and antineoplastic therapy. In contrast, oral herpes disease is typically due to herpes simplex virus type 1. Primary herpetic gingivostomatitis can result in fever, vesicles, extensive ulceration, gingival inflammation, and a decrease in oral intake while secondary infection typically leads to localized lesions. The lesions are different spread and systemic reactions, thus clinical differentiation from aphthous ulcer and other viral infections is important.

Oral protozoa (not "*Entamoeba junjvalus*") are found primarily in the crevices of the gums and periodontal pockets, in the form of *Entamoeba gingivalis*. It has been linked with poor dental hygiene and with periodontal inflammation, but its exact pathogenic role is yet to be established as it could be a contributing organism or an opportunistic organism which colonizes the previously inflamed tissues. The finding of this should therefore not be taken as evidence of causation without the accompanying clinical and microbiological assessment.

Oral mucosa may be involved in systemic autoimmune and inflammatory conditions by several mechanisms of autoantibody activity, immune-complex deposition, vascular inflammation, and cytokine dysregulation. A variety of oral manifestations have been reported in SLE including oral ulcers, cheilitis, erythematous lesions, fissured tongue, and oral discomfort, with varying prevalence in different populations [5]. Such abnormalities can be affected by disease activity, immunosuppressive therapy, secondary infection and nutritional deficiencies.

Behçet disease is another multisystem inflammatory condition for which the characteristic feature is recurrent oral aphthous ulcers. They are frequently painful, recurrent and present very much like normal aphthae, but may develop along with genital ulcers, inflammation of the eyes, skin lesions, vascular involvement or neurological symptoms. Recurrent oral ulcers can appear earlier than other symptoms and if an ulcer is particularly bad or persistent in a child, it is worthwhile checking for systemic symptoms.

Oral health can also be impaired by metabolic diseases. Salivary dysfunction, gingival inflammation, microbial changes, delayed healing, and high risk of oral infection are all potential complications of children with Type 1 Diabetes Mellitus, particularly if glycemic control is poor [6]. The recent clinical studies indicate that childhood diabetes can lead to decrease in the flow of saliva and elevate inflammatory mediators, leading to a decrease in periodontal tissue and reduction in mucosal protection [7]. But a systematic review and meta-analysis revealed that there was significant variation in caries estimates among children, but that poor glycemic control was typically linked to poorer oral outcomes [8].

Other clinically relevant gastrointestinal and malabsorptive disorders are also relevant. Enamel defects, angular cheilitis, delayed development of tooth eruption, recurrent aphthous stomatitis and other mucosal abnormalities have all been reported as having been linked to coeliac disease. Oral evidence suggests that oral signs and symptoms, especially in the absence of classic gastrointestinal symptoms, may aid in diagnosis in children [9]. Case-control studies have also shown oral and dental abnormalities in children with coeliac disease as compared with healthy controls [10]. Iron, folate, vitamin B12, calcium or Vitamin D deficiencies may play a role in these changes, but changes in immune regulation and chronic intestinal inflammation may also be involved [11].

Recurrent aphthous like ulcers, diffuse lip swelling, mucosal tags, cobblestone-like mucosa, angular cheilitis, and granulomatous inflammation may be the oral manifestations of Crohn disease. These signs can sometimes be seen before a person has abdominal pain, diarrhea, or weight loss or if they have problems growing. Therefore, chronic oral ulceration with gastrointestinal symptoms, unexplained anaemia or growth retardation should raise the suspicion of inflammatory bowel disease and should be referred for further investigations.

Yet another vulnerable group are children who are receiving antineoplastic therapy. Cytotoxic treatment causes injury to rapidly growing oral epithelial cells, disrupts oral flora and immune system, promotes oral mucositis and opportunistic infections. There is evidence that oral dysbiosis and *Candida albicans* colonization might be involved in the development of treatment-associated mucositis, but the results are inconclusive [12]. Oral mucositis can lead to severe pain, dysphagia, loss of nutritional intake, secondary infection and disruption of cancer therapy, making an oral systematic assessment and prevention essential [13].

Thus, the aim of the study was to investigate the prevalence and distribution of oral lesions in children, and their relationships with systemic diseases, which were previously documented, age, and sex. These relationships may help better detection of clinically important oral abnormalities at an earlier stage and foster communication between pediatricians and dentists.

2. Materials and Methods

The present study was a descriptive cross-sectional study involving 14 children who underwent clinical examination of the oral cavity at Azadi Teaching Hospital, Kirkuk Health Directorate, Kirkuk, Iraq, between January 3, 2026, and October 10, 2026. Children with complete data on age, sex, oral examination and final clinical diagnosis were included, while those with incomplete or duplicated data were not included. A trained clinician conducted the assessment in each child with the appropriate sterile disposable instruments under proper light conditions as per standard infection control measures. Clinical evaluation of the oral lesions was done systematically based on clinical appearance, anatomical location, and the clinical features of the lesions, and was classified as oral candidiasis, aphthous ulceration, or viral oral infection; microbiological or further

laboratory investigations were conducted when clinically indicated. The age was studied both continuously and categorically (<1, 1–<2, 2–<3 years and ≥3 years).

2.1 Statistical analysis

IBM SPSS Statistics version 26.0 was used to analyze data. Normality of continuous variables was tested by Shapiro–Wilk test and presented as mean±SD or median and IQR, and categorical variables as frequencies and percentages with 95% CI. The differences between the distribution of lesions by sex were tested by the Fisher–Freeman–Halton exact test and the Kruskal–Wallis test was used to compare the age distribution among the diagnostic groups. All tests were two-sided and $P < 0.05$ were regarded as statistically significant.

2.2 Ethical approval

The study was approved by the Research Ethics Committee of Azadi Teaching Hospital, Kirkuk Health Directorate, Kirkuk, Iraq. Written informed consent was obtained from the parents or legal guardians of all participating children prior to enrollment in the study.

3. Results

3.1 Summary of participants' age measurements, sex distribution, and age-group composition within the analyzed pediatric sample

The study included 14 children with a mean age of 1.55 ± 1.01 years and a median age of 1.40 years (IQR: 0.69–2.38), ranging from 0.11 to 3.20 years. There were 64.3% females and 35.7% males participating. Children aged <1 year constituted the largest age group (35.7%), followed by those aged 1–<2 years (28.6%), 2–<3 years (21.4%), and ≥3 years (14.3%).

Table 1. Demographic and Age-Distribution Characteristics of the Pediatric Study Population

Characteristic	Value
Total participants	14
Age, years, mean ± SD	1.55 ± 1.01
Age, years, median (IQR)	1.40 (0.69–2.38)
Age range, years	0.11–3.20
Female, n (%)	9 (64.3)
Male, n (%)	5 (35.7)
Age <1 year, n (%)	5 (35.7)
Age 1–<2 years, n (%)	4 (28.6)
Age 2–<3 years, n (%)	3 (21.4)
Age ≥3 years, n (%)	2 (14.3)

3.2 Frequencies, percentages, and 95% confidence intervals for the principal oral lesion categories identified in the study sample.

Oral candidiasis was the most common lesion with 10 children diagnosed (71.4% [95% CI: 45.4–88.3%]). Two children (14.3%, 95% CI 4.0–39.9%) each had aphthous ulcers and viral oral infections. Therefore, candidiasis was the predominant isolate from this lesion positive paediatric sample, although the large confidence limits suggest that it is not precise because of the small sample size.

Table 2. Distribution and Proportional Frequency of Diagnosed Oral Lesions Among the Examined Pediatric Participants

Oral lesion	n	Percentage (%)	95% CI (%)
Oral candidiasis	10	71.4	45.4–88.3
Aphthous ulcers	2	14.3	4.0–39.9
Viral oral infection	2	14.3	4.0–39.9
Total	14	100.0	N/A

3.3 Comparison of oral candidiasis, aphthous ulcers, and viral infections between sexes using an exact statistical test.

The most common diagnosis for both females and males was oral candidiasis (66.7% and 80.0%, respectively). Aphthous ulcers were found in 22.2% of females but did not occur in males, while viral oral infections were found in 11.1% of females and 20.0% of males. The gender distribution of oral lesions was not significantly different (exact $P=0.760$); however, the number of samples was small, which may reduce the precision of the statistics.

Table 3. Sex-Specific Distribution of Diagnosed Oral Lesions Among Female and Male Pediatric Participants

Oral lesion	Female (n=9), n (%)	Male (n=5), n (%)	Exact P-value
Oral candidiasis	6 (66.7)	4 (80.0)	0.760
Aphthous ulcers	2 (22.2)	0 (0.0)	
Viral oral infection	1 (11.1)	1 (20.0)	

3.4 Median age, interquartile range, and observed age range by diagnosis using the Kruskal–Wallis test.

The median age (IQR) for children with aphthous ulcers was 2.60 years (IQR: 2.30–2.90 years), those with viral oral infections 1.73 years (IQR: 1.24–2.21 years) and oral candidiasis 1.15 years (IQR: 0.60–1.80 years). The age distribution for the three diagnostic groups did not significantly differ (Kruskal–Wallis $P=0.210$), but the size and the non-uniformity of diagnostic groups prevents interpretation.

Table 4. Comparison of Participant Age Across the Three Diagnosed Pediatric Oral Lesion Categories

Oral lesion	n	Age, years, median (IQR)	Range, years	P-value
Oral candidiasis	10	1.15 (0.60–1.80)	0.11–3.00	0.210
Aphthous ulcers	2	2.60 (2.30–2.90)	2.00–3.20	
Viral oral infection	2	1.73 (1.24–2.21)	0.75–2.70	

3.5 Age-stratified frequencies and within-group percentages of oral candidiasis, aphthous ulcers, and viral oral infections.

Oral candidiasis was the most common disease among children less than 2 years old (80.0% in children <1 year and 100.0% in children 1–<2 years). Candidiasis, aphthous ulcers and viral infections were equally distributed in children 2–<3 years with 33.3% each. For children ≥3 years old, 50.0% of the diagnoses were candidiasis and 50.0% were aphthous ulcers. Candidiasis made up 71.4% of all lesions recorded overall, but should be viewed with caution due to the small numbers of lesions in each age group.

Table 5. Distribution of Diagnosed Oral Lesion Categories Across Age Groups in the Pediatric Study Sample

Age group	Oral candidiasis, n (%)	Aphthous ulcers, n (%)	Viral oral infection, n (%)	Total, n (%)
<1 year	4 (80.0)	0 (0.0)	1 (20.0)	5 (35.7)
1–<2 years	4 (100.0)	0 (0.0)	0 (0.0)	4 (28.6)
2–<3 years	1 (33.3)	1 (33.3)	1 (33.3)	3 (21.4)
≥3 years	1 (50.0)	1 (50.0)	0 (0.0)	2 (14.3)
All ages	10 (71.4)	2 (14.3)	2 (14.3)	14 (100.0)

4. Discussion

The present findings are reporting the prevalence of oral lesions among children and not the population prevalence of oral lesions since the data set only covered children with a diagnosis; not including children that had no oral lesions. Oral candidiasis was the most common (71.4%) while aphthous ulcers was 14.3% and viral oral infection was 14.3% of the lesions diagnosed. Estimates of the prevalence of candidiasis are much lower in population-based pediatric studies. Owczarek-Drabińska et al. noted significant differences in the prevalence of oral-mucosal lesions among children based on age, population characteristics and the method of diagnosis [14]. In a similar way, Guillouet et al. reported that candidiasis is usually rare in healthy children, but occurs more frequently in infants and in people with decreased immune function [15]. It should be noted that the rate of 71.4% in this report refers to the percentage of lesions with candidiasis, rather than the percentage of lesions present in the community.

This is a relatively high rate of candidiasis, however, consistent with evidence from clinically selected and/or high-risk pediatric groups. In addition to the above, Mushi et al. have shown the prevalence of oral candidiasis even in HIV-negative children, especially in areas with poor availability of fungal diagnostic services and poor investigation of predisposing conditions [16]. Alkhars et al. have also reported the early colonization of *Candida* species in infancy, and that this rate of colonization rises with age up to the first six months of life [17]. Moreover, the use of inhaled corticosteroid has been linked to oral candidiasis in children with asthma due to the ability to suppress the host immune system locally, decrease salivary clearance, and the presence of residual inhaled drug for fungal overgrowth [18]. Another recent retrospective study by Kakoschke et al. also found that pediatric orofacial candidiasis has different clinical forms that are related to age, immune status, antibiotic use and underlying disease [19]. The biological plausibility of the predominance of candidiasis in the sample of children with median age of 1.40 years was supported by these studies.

When analysed by age, it was found that 8 out of 9 children younger than 2 years were infected with the candida species. It may be a reflection of immature mucosal immunity, development of oral flora, frequent bottle feeding, restricted clearance of oral cavity as well as early colonization with *Candida*. However, age was not significantly different in the three groups (Kruskal–Wallis $P=0.210$). Therefore the prevalence of candidiasis in young children observed should not be interpreted as conclusive for an age effect. The lack of statistical significance might be due to small sample size as only 2 children were included in each of the two groups: aphthous ulcers and viral infections. Thus, it is not possible to rule out a clinically relevant age-related effect.

Aphthous ulcers were reported at 14.3% of all lesions and in a higher median age than candidiasis but these differences were not significant. This finding is consistent with the clinical review by Légeret and Furlano, who estimated the prevalence of oral ulcers to be around 9% of children and pointed out that they are a very heterogeneous condition

caused by a variety of infectious, nutritional, hematologic, gastrointestinal, and autoinflammatory factors [20]. The recurrent aphthous stomatitis was also defined as a multifactorial inflammatory disorder, which is related to trauma of the oral mucosa, immune system dysfunction, nutritional deficiencies, genetic predisposition, and systemic disease by D'Amario et al. [21]. This slightly higher proportion may be due to the sampling design of the present dataset, which sampled lesions, rather than the actual proportion of the population that is afflicted with such lesions.

Especially, watch for the relationship of aphthous lesions and systemic disease. In children newly diagnosed with inflammatory bowel disease, Klichowska-Palonka et al. noticed more aphthous stomatitis and angular cheilitis compared to controls, but their overall comparison failed to be statistically significant [22]. Pecci-Lloret et al. performed a systematic review that concluded aphthous ulcers, gingivitis, lip swelling and angular cheilitis are key oral complications of Crohn's disease [23]. Oral extraintestinal manifestations can also lead to gastrointestinal disease, which may aid early referral of children with inflammatory bowel disease, Shazib et al. also reported [24]. These studies concur that the two aphthous cases in this dataset might have given clinically relevant clues to systemic disease, but it is not established that gastrointestinal disease was present due to the lack of recording of systemic diagnoses.

Another potential explanation is hematological disorders. Soares et al. reported the oral ulceration, mucositis, candidiasis, gingival changes and herpesvirus infection among children with acute lymphoblastic leukemia [25]. In a systematic review and meta-analysis, Silveira et al. showed that a large number of leukemia children had oral problems, both due to leukemia and its therapy [26]. The results might account for the increased incidence of oral lesions found in medically compromised specimens. This is a speculative application if it were to be used directly with the current children without full blood counts, immune evaluations, treatment experiences and diagnosis of the underlying hematological diseases.

14.3% of cases were viral oral infections. Likewise, Moca et al. described ulcers, erythematous lesions, lip changes and tongue alterations in children with COVID-19, but reported significant variations in the definitions of the diagnosis [27]. Viral injury, activation of the immune system, effects of treatment, and secondary infections may all play a role in pediatric oral lesions, as suggested by Di Spirito et al. [28]. On the other hand, the work of Kot et al. suggests that there is lack of consistent evidence to establish a direct causal relationship between SARS-CoV-2 and oral mucosal lesions [29]. A possible explanation for this apparent discrepancy is differences in the virus confirmed, time assessed, comorbidities, medications and failure to differentiate primary viral infection from subsequent opportunistic infection. In this study, the term viral oral infection is a broad term and without PCR or serological results, the organisms cannot be specified.

The number of females was 64.3% of the total sample, but there was no significant difference in the distribution of lesions between the sexes ($P=0.760$). Candidiasis was seen in 66.7% of females and 80.0% of males; aphthous ulcers were only reported in females. The differences between the two should not be interpreted biologically as the absolute numbers were very small. The size of the confidence interval (45.4% - 88.3%) is another indication of the uncertainty of the estimate.

In addition, recent research of neutropenia has shown that recurrent ulcers, gingivitis, periodontitis and opportunistic infections may be early signs of a defect in innate immunity [30]. Teodorescu et al. identified systemic associations with oral or periodontal abnormalities in pediatric patients but highlighted that the associations between oral or periodontal abnormalities and systemic conditions were not causal [31]. In general, current evidence on oral-systemic health suggests a comprehensive medical/dental evaluation, especially for children with recurrent, severe or atypical lesions [32].

The sample size is the primary drawback, but the variables are not really the ones that could be used with the goal to be achieved. Prevalence is not possible if the total number of children examined and a lesion-free comparison group are not available. Similarly, if they have no evidence of systemic disease, then their relationship with oral disease cannot be tested. The study can best be described as a small descriptive case series at this time. For a larger investigation, then, children should be screened in a consecutive manner, lesion-negative controls should be included, the clinical or laboratory diagnosis should be standardized, systemic diagnoses, medication and antibiotic use, nutritional status, immune markers, and multivariable analysis should be included.

5. Conclusion

Oral candidiasis was the most common oral lesion observed in this paediatric population, with aphthous ulcers and viral oral infections being less common. There was no statistically significant difference in the distribution of lesions by sex or age, however, due to small sample size and differences in the diagnostic groups, there was limited statistical power and precision. The results show that candidiasis is a significant oral condition in young children who were examined clinically and highlights the need for a careful evaluation of the oral mucosa when children are seen for routine care. The findings do not, however, represent prevalence in the population, but can only be used to describe the pattern of lesions. It is important to confirm these observations and pinpoint independent factors in larger, population-based studies that include lesion-free individuals, microbiological confirmation, systemic disease, medication use, nutrition and immune characteristics.

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