GMR
The Original

# PREVALENCE OF ORAL MUCOSAL LESIONS- GEOGRAPHIC TONGUE, RECURRENT APTHOUS STOMATITIS AND FISSURED TONGUE IN CHILDREN AND ADOLESCENTS.: A SYSTEMATIC REVIEW AND META-ANALYSIS

**Dr. Mandavi S. Waghmare[1], Dr. Sandeep S. Pagare[2], Dr. Kapil Gavand[3], Dr. Vagisha Choudhary[4], Dr. Bhavika Pol Vhatkar[5], Dr. Nisha Bharos[6]**

[1]Department Oral Medicine and Radiology , D.Y.Patil University School of Dentistry, Email id: mandavi.waghmare@dypatil.edu, Designation: Professor and HOD, Orcid id: 0000000189191218
[2]Department Oral Medicine and Radiology , D.Y.Patil University School of Dentistry, Email id: professorpagare@gmail.com, Designation: Professor, Orcid id: 0000000183267576
[3]Department Oral Medicine and Radiology , D.Y.Patil University School of Dentistry, Email id: kapil.gavand@dypatil.edu, Designation: Associate Professor, Orcid id: 0009000722350625
[4]Post graduate student, Department Oral Medicine and Radiology, D.Y.Patil University School of Dentistry, Email id: vagishac14@gmail.com, Orcid id: 0009-0009-5941-2628
[5]Associate professor, Department Oral Medicine and Radiology , D.Y.Patil University School of Dentistry, Email id:drpolvhatkar@gmail.com, Orcid id: 0009-0004-9830-5976
[6]Postgraduate student, Department Oral Medicine and Radiology , D.Y.Patil University School of Dentistry, Email id: nishabharos0805@gmail.com, Orcid id: 0009-0004-3936-5637

**ABSTRACT:**
**Background:** Oral mucosal lesions (OMLs) represent the third most common oral pathology after dental caries and periodontal disease, yet epidemiological data in pediatric populations remain limited and highly variable. This systematic review and meta-analysis directed to determine the pooled prevalence of three specific OMLs geographic tongue (GT), recurrent aphthous stomatitis (RAS), and fissured tongue (FT) in children and adolescents.
**Methodology:** A systematic search of PubMed, Google Scholar, and EBSCO databases was conducted for cross-sectional studies published between January 2002 and December 2022 reporting prevalence of GT, RAS, and FT in pediatric populations. The Newcastle-Ottawa Scale adapted for cross-sectional studies was used for assessment of risk of bias. Meta-analysis was performed using a random-effects model with Freeman-Tukey double-arcsine transformation.
**Results:** Fifteen studies were comprised which met inclusion criteria. The pooled prevalence was 4% (95% CI: 2%-5%) for geographic tongue, 4% (95% CI: 3%-6%) for recurrent aphthous stomatitis, and 2% (95% CI: 0%-3%) for fissured tongue. Substantial heterogeneity was observed across studies ($I^2 > 97\%$). GT was more prevalent in younger children (0-6 years), while fissured tongue increased with age. Recurrent aphthous stomatitis showed significant association with systemic diseases, particularly gastrointestinal disorders and anemia.
**Conclusion:** This review established that geographic tongue, recurrent aphthous stomatitis, and fissured tongue are relatively common in pediatric populations, with prevalence patterns varying by age.

**KEYWORDS:** Geographic tongue, recurrent apthous stomatitis, fissured tongue, glossitis

## INTRODUCTION

Oral Mucosal Lesions (OML) refer to a variety of abnormalities associated with the oral mucosa and can be manifested by color change, mucosal surface changes, inflammation, ulceration, and mucosal breakdown (Neville et al., 2016). These lesions occur across different age groups and geographic populations and comprise a diverse spectrum of oral conditions (Gonsalves et al., 2007). Among children, lesions of the oral mucosa form an important part of oral health care; however, studies on the prevalence of these conditions remain scarce when compared to the prevalence of tooth decay and gum diseases (Jaganathan et al., 2015). Oral health surveys based on the population are useful for the determination of disease prevalence and planning (Organization, 2013).

Epidemiological studies contribute valuable information on the frequency, distribution, and potential determinants of oral mucosal disorders, despite the fact that variations in the methodology of such research can have an effect on results obtained (Kleinman et al., 1991). Consequently, considerable variation has been observed among paediatric surveys, making direct comparison between studies difficult because of

methodological and diagnostic differences (Braga et al., 2015). A systematic review of oral mucosal lesions in children and adolescents similarly demonstrated wide variation in reported prevalence across populations, with geographic tongue, fissured tongue, and recurrent aphthous stomatitis among the commonly reported conditions (De Paula et al., 2021).

### 1.1 Geographic Tongue

Geographic tongue, also known as benign migratory glossitis or erythema migrans, is a benign, chronic, recurring inflammatory condition of unclear etiology (Assimakopoulos et al., 2002; Klein et al., 2026). It is characterized by multiple well-demarcated areas of erythema due to atrophy of filiform papillae, surrounded partially or completely by slightly elevated, white scalloped borders (Jainkittivong & Langlais, 2005; Picciani et al., 2016). The literature shows wide variation in prevalence, ranging from 0.37% to 14.3% (J. Shulman & Carpenter, 2006; Miloğlu et al., 2009; Renert-Yuval & Guttman-Yassky, 2019). Geographic tongue typically begins in childhood (between 6 and 12 months) and is most frequently observed in children aged approximately four to four-and-a-half years (Iqbal et al., 2017). According to authors, the difference in prevalence among age groups may indicate that non-genetic factors participate in the multifactorial etiology (Pinna et al., 2019).

### 1.2 Recurrent Aphthous Stomatitis

Recurrent aphthous stomatitis (RAS), also referred to as aphthous ulcer or canker sores, affects 10-20% of the population and is the most common oral ulcerative disease (Herrera González et al., 2014; Scully & Porter, 2008). RAS is clinically characterized by multiple ulcers in the oral cavity that heal within 7-14 days (Jurge et al., 2006; Parra-Moreno et al., 2022). The prevalence during 1986-1996 ranged between 1.23% and 10.8% (Baccaglini et al., 2011). Despite intensive research, the definitive etiology remains unknown, though genetic predisposition with strong associations with interleukin genotypes and sometimes family history has been identified (Manfredini et al., 2021; Evereklioglu, 2011).

### 1.3 Fissured Tongue

FT is a developmental anomaly of the dorsum of the tongue, clinically described by grooves varying in depth along the dorsal and lateral aspects. These deep fissures may trap food debris, leading to inflammation, secondary fungal infection, and halitosis. Patients are usually asymptomatic, and the condition often requires no treatment beyond maintaining good oral hygiene. Literature reveals wide variability in prevalence worldwide, from 1.49% to 23% (Jabbarian et al., 2025). Increased prevalence may be due to factors such as salivary hypofunction, vitamin B deficiency, and candidiasis (Ziaei et al., 2022).

Soft tissue oral illnesses may be investigated due to the lack of epidemiologic data in this field. The epidemiologic literature on children and adolescents is still very small, despite recommendations from the World Health Organization. This systematic review was carried out to examine the prevalence of oral mucosal lesions in children and to direct further studies in this field.

### 1.4 Research question

“What is the prevalence of OMLs- geographic tongue, recurrent apthous stomatitis and fissured tongue in children and adolescents?”

### Objectives

To conclude the pooled prevalence of GT, RAS, and FT amongst children and adolescents.

To associate the prevalence patterns of these oral mucosal lesions across different age groups and geographic populations.

To evaluate the methodological quality and ROB of the studies involved in the systematic review and meta-analysis.

## 2. MATERIALS AND METHODS

### 2.1 Protocol and registration

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses PRISMA 2021 reporting standards for systematic reviews and meta-analyses (Page et al., 2021), and was prospectively enrolled in PROSPERO (ID: CRD420251251465).

### 2.2 Eligibility criteria

Original cross-sectional studies published in English between 1 January 2002 and 31 December 2022 that evaluated the prevalence of OMLs in children and adolescents (0–18 years), included the predefined search terms in the title, abstract, or keywords, and were available as free full-text articles were included, whereas cohort studies, case-control studies, case reports, case series, reviews, editorials, conference abstracts, non-English articles, studies involving adults, duplicate publications, and studies not specifically reporting the prevalence of ORLs were excluded.

### 2.3 Search strategy and methodology

A systematic search was handled in Medline through PubMed, Google Scholar, and EBSCO from 01/01/2002 to 31/12/2022. The search strategy utilized terms for population (Children, Adolescents, Infants), comparison (Geographic tongue, glossitis benign migratory, recurrent aphthous stomatitis, stomatitis aphthous, fissured tongue), outcome (Prevalence of OMLs), and study design (Cross-sectional studies). The complete search strategy and search terms used for the systematic review are confirmed in Table 1.

**Table 1. Search Strategy**

| Category | Search terms |
|---|---|
| Population | Children*[Title/Abstract]<br>Adolescents* [Title/Abstract],<br>Infants*[Title/Abstract] |
| Comparison | Geographic tongue*[Title/Abstract<br>"glossitis, benign migratory"*[Title/Abstract]<br>"Recurrent aphthous stomatitis" *[Title/Abstract]<br>"Stomatitis, Apthous "*[Title/Abstract]<br>Fissured Tongue*[Title/Abstract] |
| Outcome | Prevalence of oral mucosal lesions |
| Study design | Cross-sectional studies* |
| | 1 AND 2 AND 3 AND 4 |

**2.4 Selection Process**

Two separate reviewers (MW and VC) got full-text versions of the qualifying studies and thoroughly examined them for inclusion. Ambiguities and disputes were settled.

**2.5 Data extraction and data items**

Data were independently extracted using a standardized form capturing author, year, age group, study design and comparator type was recorded as mentioned in Table 2.

**Table 2. Data Extraction**

| Sr no. | Author's names, year of study & geographical location | Sample Size | | | Type of Study | Geographic Tongue | Recurrent Aphthous Stomatitis | Fissured Tongue |
|---|---|---|---|---|---|---|---|---|
| | | TOTAL | MALE | FEMALE | | | | |
| 01. | (A. A. Hussein et al., 2017) | 1366 | 639 | 727 | Retrospective Cross sectional study | 16.8% | 1.2% | 14.6% |
| 02. | (Amadori et al., 2017) | 6374 | 3387 | 2987 | Cross sectional study | 9.6% | 18% | |
| 03. | (Ambika et al., 2011) | 1003 | 459 | 544 | Cross sectional study | 1.4% | 0.1% | 4.9% |
| 04. | (Bessa et al., 2004) | 1211 | 571 | 640 | Cross sectional study | 30.5% | 5.19% | 4.92% |
| 05. | (Boras et al., 2013) | 142 | 72 | 70 | Retrospective Cross sectional study | 13.38% | 14.08% | 1% |
| 06. | (Garcia-Pola et al., 2002) | 243 | 117 | 126 | Retrospective Cross sectional study | 8.16% | 4.08% | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 07. | (Owczarek-Drabińska et al., 2022) | 143 | 83 | 60 | Retrospective Cross sectional study | 5.6% | 1.89% | |
| 08. | (Majorana et al., 2010) | 10128 | 5874 | 4254 | Retrospective Cross sectional study | 10% | 14.8% | 0.38% |
| 09. | (Ünür et al., 2015) | 1041 | 551 | 490 | Cross sectional study | 6.49% | 8.66% | 12.63% |
| 10. | (S. A. Hussein & Noori, 2014) | 5113 | 2757 | 2356 | Cross sectional study | 1.33% | 2.25% | 0.64% |
| 11. | (J. D. Shulman, 2005) | 914 | | | Cross sectional study | 1.05% | 1.64% | 0.08% |
| 12. | (Yañez et al., 2016) | 101 | 47 | 54 | Cross sectional study | 1% | 6.9% | 1% |
| 13. | (Yilmaz et al., 2011) | 299 | 154 | 145 | Cross sectional study | 2.68% | 0.67% | |
| 14 | (Yao et al., 2022) | 3145 | | | Cross sectional study | 8.5% | | 6.7% |
| 15. | (Vieira-Andrade et al., 2013) | 541 | 281 | 260 | Cross sectional study | 2.8% | | 0.6% |

2.6 Risk of bias and certainty assessment

The methodological quality and risk of bias of the included studies were assessed using the Newcastle–Ottawa Scale (NOS) adapted for cross-sectional studies (Wells et al., 2000). The scale estimates three domains: selection (max. five stars), comparability (max. one star), and outcome assessment (maximum two stars), with a total possible score of eight stars. Studies scoring 7–8 stars were regard as to have a low ROB, those scoring 5–6 stars a moderate risk, and those scoring ≤4 stars a high risk of bias. The ROB consideration of the included studies using the Newcastle–Ottawa Scale is presented in Table 3.

**Table 3. Risk of Bias within Individual Studies**

| **Author** | **Year** | **Selection** | | | | **Comparability** | **Outcome** | | **Total** | **RoB** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Representativeness of the sample | Sample size | Non-respondents | Ascertainment of exposure | Confounding controlled | Outcome assessment | Statistical test | | |
| (A. A. Hussein et al., 2017) | 2017 | * | * | * | ** | | * | * | 7 | Low |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (Amadori et al., 2017) | 2017 | | * | * | * | * | * | * | 6 | Medium |
| (Ambika et al., 2011) | 2011 | * | * | * | ** | | * | * | 7 | Low |
| (Vieira-Andrade et al., 2013) | 2013 | * | * | * | ** | * | * | * | 8 | Low |
| (Bessa et al., 2004) | 2004 | * | | * | ** | * | * | * | 7 | Low |
| (Boras et al., 2013) | 2013 | | | | ** | | * | * | 4 | High |
| (Garcia-Pola et al., 2002) | 2002 | * | * | | ** | | * | * | 6 | Medium |
| (Yao et al., 2022) | 2022 | * | * | * | ** | * | * | * | 8 | Low |
| (Owczarek-Drabińska et al., 2022) | 2022 | * | | * | ** | | * | * | 6 | Medium |
| (Majorana et al., 2010) | 2010 | * | * | * | ** | * | * | * | 8 | Low |
| (Ünür et al., 2015) | 2015 | | | * | ** | | * | * | 5 | Medium |
| (S. A. Hussein & Noori, 2014) | 2014 | * | * | * | ** | | * | * | 6 | Medium |
| (J. D. Shulman, 2005) | 2005 | * | * | * | ** | * | * | * | 8 | Low |
| (Yañez et al., 2016) | 2016 | | * | | ** | | * | * | 5 | Medium |
| (Yilmaz et al., 2011) | 2011 | | | * | ** | | * | * | 4 | High |

**2.7 Statistical Analysis**

Statistical analyses were accomplished using Meta XL version 5.1 with 95% confidence intervals (CI) and 95% prediction intervals (PI) for future prevalence estimations. The Freeman-Tukey double-arcsine transformation was used for variance stabilization of proportions (Freeman & Tukey, 1950) before pooling data with the random-effects model (DerSimonian & Laird, 1986). Chi-square and Tau-square assessed

homogeneity/heterogeneity among studies. Heterogeneity was assessed using $I^2$ with thresholds of ≥25%, ≥50%, and ≥75% indicating low, moderate, and high heterogeneity, respectively (Higgins et al., 2003). Funnel plots and Doi plots with LFK indices were constructed to examine publication bias (Furuya-Kanamori et al., 2018).

## 3. RESULTS

Total of 306 articles were recognised after screening on PUBMED and GOOGLE SCHOLAR and EBSCO from which 32 duplicate articles were removed, remaining 274 articles were screened amongst which free full texts were not available for 174 articles, so the remaining 100 full text articles were evaluated for eligibility, amongst which 85 articles did not match the inclusion criteria, and therefore remaining 15 free full texts were incorporated for qualitative analysis and quantitative analysis (Figure 1).

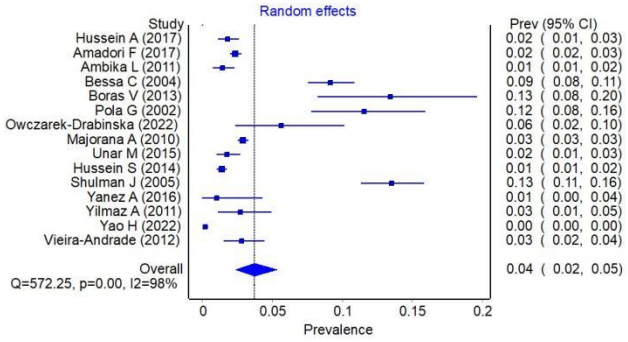


**Figure 1 presents Forest plots showing Pooled prevalence of Geographic Tongue**

### 3.1 Study characteristics

Fifteen cross-sectional studies including 33,812 children and adolescents assessed the prevalence of OMLs, geographic tongue (GT), recurrent aphthous stomatitis (RAS), and fissured tongue (FT) (Piyarathne et al., 2023; Majorana et al., 2010; Fernandes, 2019). All fifteen studies reported the prevalence of GT (Bessa et al., 2004; Escuin, 2020; Lešić et al., 2019), thirteen studies reported the prevalence of recurrent aphthous stomatitis (Gaber et al., 2022; Bachanek et al., 2018; Cagetti et al., 2019), and eleven studies reported the prevalence of FT (J. D. Shulman, 2005; PALATE, 2024). The included studies were conducted across multiple geographic regions including Brazil, Italy, USA, Turkey, Jordan, Iraq, India, Croatia, Spain, Poland, Chile, and China (ALTINTAŞ, 2025; Scardueli et al., 2017; Zhang et al., 2023).

### 3.2 Quantitative assessment of data

The pooled prevalence of GT, estimated from 15 studies, was 4% (95% CI: 2%–5%; $I^2$ = 98%). The forest plot for the pooled prevalence of GT is showed in Figure 2.

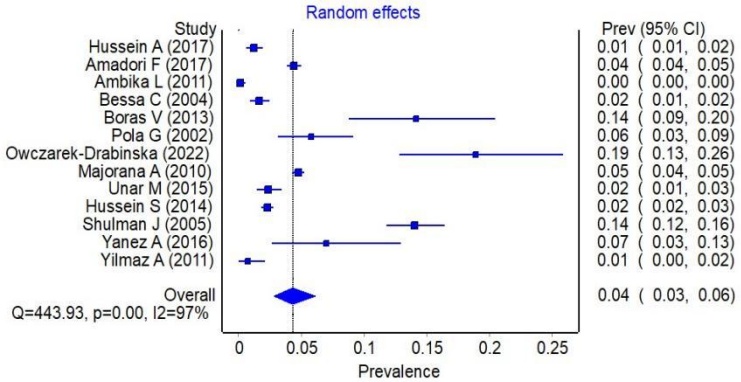


**Figure 2 presents forest plots of Recurrent aphthous ulcer among children and adolescents**

Higher prevalence was reported among younger children (0–6 years), with the highest estimates observed in studies from Brazil (30.5%), Croatia (13.38%), and Italy (9.6%), whereas lower prevalence was reported in the United States (1.05%) and Turkey (2.68%). Recurrent aphthous stomatitis (RAS), based on 13 studies, demonstrated a pooled prevalence of 4% (95% CI: 3%–6%; $I^2$ = 97%) and was the most mutual oral mucosal lesion amongst children aged 0–13 years and the second most common among adolescents (Figure 3).

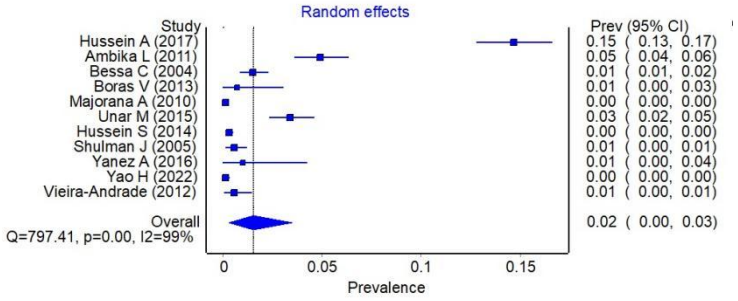


**Figure 3 presents forest plots of Fissured tongue among children and adolescents**

Increased prevalence was reported in children with systemic conditions, particularly gastrointestinal disorders and anaemia, with the highest rates observed in Italy (18%) and Croatia (14.08%). Fissured tongue, evaluated across 11 studies, had a pooled prevalence of 2% (95% CI: 0%–3%; $I^2$ = 99%) and was more frequently observed in older children, with reported associations with allergy and congenital anomalies. The highest prevalence was reported from Jordan (14.6%) and Istanbul (12.63%), while the lowest prevalence was observed in the United States (0.08%) and Italy (0.38%).

### 3.3 Risk of Bias and certainty Assessment

Out of 15 studies, seven were categorized as low ROB, six as moderate risk, and two as high risk. The primary methodological concerns included lack of standardized diagnostic criteria, incomplete reporting of examiner calibration, and failure to report confidence intervals.

## 4. DISCUSSION

This SLR investigated the limited existing proof concerning the prevalence of OMLs in children and adolescents. To the best of the authors' knowledge, this is the first SLR with meta-analysis concerning the prevalence of these specific oral mucosal lesions in paediatric populations.

### 4.1 Geographic Tongue

The pooled prevalence of GT was 4% (95% CI: 2%-5%), which is consistent with previous literature reporting a global relative frequency of approximately 1-3% (Cebeci et al., 2009). Several authors reported higher prevalence in young children (0-6 years), hypothesizing that non-genetic multifactorial factors are contributory (Miloğlu et al., 2009). Pinna et al. revealed a strong difference between age groups, with children under ten years more likely to have migratory glossitis (Pinna et al., 2019). Deficiencies in nutrients such as zinc or vitamin B may contribute to geographic tongue development. Most children with GT are asymptomatic, but indicators like pain, burning sensation, soreness, and sensitivity to hot/spicy food can occur.

### 4.2 Recurrent Aphthous Stomatitis

The pooled prevalence of RAS was 4% (95% CI: 3%-6%), consistent with earlier reports of 1.23%-10.8%. Earlier studies suggested RAS was associated with lower socioeconomic status, but Bessa et al. found no socioeconomic correlation (Bessa et al., 2004). Predisposing factors involve trauma, emotional stress, poor nutritional status, thiamine deficiency, and zinc deficiency. According to the scoping review by Salwaji et al., aphthous ulcers are the first and most prevalent OML among the world's pediatric population (Salwaji et al., 2025). Notably, RAS may predate the enhancement of fully symptomatic disease by various years or decades, with 99% of patients with Behcet's disease presenting oral aphthae.

### 4.3 Fissured Tongue

The pooled prevalence of FT was 2% (95% CI: 0%-3%). Increase in prevalence may be due to factors such as salivary hypofunction, vitamin B deficiency, and candidiasis. Many authors suggest higher prevalence of FT in children with geographic tongue. Bessa et al. reported a strong association of fissured tongue with allergy. Salwaji et al. reported the frequency of fissured tongue as 0.3-4% (Salwaji et al., 2025).

Braga et al. pointed out that while there were several surveys pertaining to the prevalence of various disorders, stated prevalences differed, and few research were directly equivalent in terms of the technique used. The diagnostic criteria and detection technique used varied significantly between surveys.

## 5. CONCLUSION

According to the review, the most often OMLs in children across all regions are similar in clinical study data. Geographic tongue is more common in children than fissured tongue, which rises with age. Geographic tongue, recurrent aphthous stomatitis, and fissured tongue had pooled prevalence rates of 4%, 4%, and 2%, respectively. There is a dearth of epidemiologic research on children and adolescents in this area, despite recommendations from the World Health Organization. Better epidemiological research is required in this field. This systematic review emphasizes that there is a requirement to conduct standardized studies regarding the prevalence of OMLs in children, which require larger sample sizes.

## 6. LIMITATIONS

Several drawbacks exist in the current review. High heterogeneity existed among the included studies, especially about design, subjects, and outcomes, which could have biased the pooled estimates. Additionally, the lack of standard diagnostic criteria used in defining oral mucosal conditions prevented comparability between the studies. Differences in the causes and age distribution, together with the insufficient methodology description in some studies, could have posed a source of bias. Publication bias was evident in geographic tongue and fissured tongue, and the insufficient geographical diversity of the included studies poses a problem of generalizability of the results.

## REFERENCE


1. ALTINTAŞ, N. Y. (2025). Güncel Ağız Diş Çene Cerrahisi V. Akademisyen Kitabevi. https://books.google.com/books?hl=en&lr=&id=hymcEQAAQBAJ&oi=fnd&pg=PA16&dq=20.%09Koseoglu+S,+Caglayan+F,+Koseoglu+BG.+Prevalence+of+tongue+lesions+in+Turkish+children.+Int+J+Paediatr+Dent.+2012%3B22(4):275-9.&ots=JZyZwdtKd9&sig=2pRv4rTcVUQaK6CqzYxN4InI0dg
2. Amadori, F., Bardellini, E., Conti, G., & Majorana, A. (2017). Oral mucosal lesions in teenagers: A cross-sectional study. Italian Journal of Pediatrics, 43(1), 50. https://doi.org/10.1186/s13052-017-0367-7
3. Ambika, L., Keluskar, V., Hugar, S., & Janaina Salomon, G. (2011). Prevalence of oral mucosal lesions and variations in Indian public school children. Brazilian Journal of Oral Sciences, 10(4), 288–293.
4. Assimakopoulos, D., Patrikakos, G., Fotika, C., & Elisaf, M. (2002). Benign migratory glossitis or geographic tongue: An enigmatic oral lesion. The American Journal of Medicine, 113(9), 751–755.
5. Baccaglini, L., Lalla, R., Bruce, A., Sartori-Valinotti, J., Latortue, M., Carrozzo, M., & Rogers, R. (2011). Urban legends: Recurrent aphthous stomatitis. Oral Diseases, 17(8), 755–770. https://doi.org/10.1111/j.1601-0825.2011.01840.x
6. Bachanek, T., Hendzel, B., Wolanska, E., Szybinsky, V., Ogonovsky, R., Hrynovets, V., Samborski, D., Nakonieczna-Rudnicka, M., & Chalas, R. (2018). Prevalence of dental erosion among 18-year-old adolescents in the borderland districts of Lviv (Ukraine) and Lublin (Poland). Annals of Agricultural and Environmental Medicine, 25(1). https://agro.icm.edu.pl/agro/element/bwmeta1.element.agro-a2f31953-d24a-435f-b40e-19d721d1da34
7. Bessa, C. F. N., Santos, P. J. B., Aguiar, M. C. F., & Do Carmo, M. A. V. (2004). Prevalence of oral mucosal alterations in children from 0 to 12 years old. Journal of Oral Pathology & Medicine, 33(1), 17–22.
8. Boras, V. V., Rogulj, A. A., Alajbeg, I., Škrinjar, I., Brzak, B. L., Brailo, V., Juras, D. V., & Verzak, Ž. (2013). The prevalence of oral mucosal lesions in Croatian children. Paediatria Croatica, 57(3), 235–238.
9. Braga, M. M., Floriano, I., Ferreira, F. R., Silveira, J. M., Reyes, A., Tedesco, T. K., Raggio, D. P., Imparato, J. C. P., & Mendes, F. M. (2015). Are the Approximal Caries Lesions in Primary Teeth a Challenge to Deal With?—A Critical Appraisal of Recent Evidences in This Field. In Emerging Trends in Oral Health Sciences and Dentistry. IntechOpen. https://www.intechopen.com/chapters/48186
10. Cagetti, M. G., Marcoli, P. A., Berengo, M., Cascone, P., Cordone, L., Defabianis, P., De Giglio, O., Esposito, N., Federici, A., Laino, A., Majorana, A., Nardone, M., Pinchi, V., Pizzi, S., Polimeni, A., Privitera, M. G., Talarico, V., & Zampogna, S. (2019). Italian guidelines for the prevention and management of dental trauma in children. Italian Journal of Pediatrics, 45(1), 157. https://doi.org/10.1186/s13052-019-0734-7
11. Cebeci, A. R., Gülşahi, A., Kamburoglu, K., Orhan, B.-K., & Oztaş, B. (2009). Prevalence and distribution of oral mucosal lesions in an adult Turkish population. Med Oral Patol Oral Cir Bucal, 14(6), E272-7.
12. De Paula, D. S., Nóbrega Malta, C. E., De Brito, W. H., Mota Lemos, J. V., Cetira Fillho, E. L., Gurgel Costa, F. W., Nunes Alves, A. P. N., & De Barros Silva, P. G. (2021). Prevalence of malignant neoplastic oral lesions among children and adolescents: A systematic review and meta-analysis. International Journal of Paediatric Dentistry, 31(4), 504–519. https://doi.org/10.1111/ipd.12765
13. DerSimonian, R., & Laird, N. (1986). Meta-analysis in clinical trials. Controlled Clinical Trials, 7(3), 177–188.
14. Escuin, T. (2020). Med Oral Patol Oral Cir Bucal. https://www.academia.edu/download/101571179/medoralv17_i3_p512.pdf
15. Evereklioglu, C. (2011). Ocular Behçet disease: Current therapeutic approaches. Current Opinion in Ophthalmology, 22(6), 508–516.
16. Fernandes, M. E. (2019). Prevalence of Tobacco Habit and Associated Oral Lesions [Master's Thesis, Rajiv Gandhi University of Health Sciences (India)]. https://search.proquest.com/openview/508463c9c71200250e3df399cf386136/1?pq-origsite=gscholar&cbl=2026366&diss=y
17. Freeman, M. F., & Tukey, J. W. (1950). Transformations related to the angular and the square root. The Annals of Mathematical Statistics, 607–611.
18. Furuya-Kanamori, L., Barendregt, J. J., & Doi, S. A. (2018). A new improved graphical and quantitative method for detecting bias in meta-analysis. JBI Evidence Implementation, 16(4), 195–203.
19. Gaber, Y. A., Al-Sanabani, R., Annuzaili, D. A., Al-Danakh, A., & Ling, L. C. (2022). Research progress of health care in Yemeni children during the war. Primary Health Care Research & Development, 23, e55.

20. Garcia-Pola, M. J., Garcia-Martin, J. M., & Gonzalez-Garcia, M. (2002). Prevalence of oral lesions in the 6-year-old pediatric population of Oviedo (Spain). Medicina Oral: Organo Oficial de La Sociedad Espanola de Medicina Oral y de La Academia Iberoamericana de Patologia y Medicina Bucal, 7(3), 184–191.
21. Gonsalves, W. C., Chi, A. C., & Neville, B. W. (2007). Common oral lesions: Part II. Masses and neoplasia. American Family Physician, 75(4), 509–512.
22. Herrera González, D., Alonso Álvarez, B. M., Arriba De La Fuente, L. D., Santa-Cruz Astorqui, I., Serrano, C., & Sanz Alonso, M. (2014). Acute periodontal lesions. https://docta.ucm.es/entities/publication/a1b11737-0778-4440-bb39-fe587781570c
23. Hussein, A. A., Darwazeh, A. M., & Al-Jundi, S. H. (2017). Prevalence of oral lesions among Jordanian children. Saudi Journal of Oral Sciences, 4(1), 12–17.
24. Hussein, S. A., & Noori, A. J. (2014). Prevalence of oral mucosal changes among 6-13-year old children in Sulaimani city, Iraq. Sulaimani Dent. J, 1, 5–9.
25. Iqbal, M. A. I., Abid, M., Khan, A. A., Mohol, J., & Mohsina, N. (2017). Geographic Tongue in children. Bangladesh Journal of Dental Research & Education, 7(1), 47–50.
26. Jabbarian, R., Ranjbaran, M., Mokhlesi, A., & Hosseini, S. (2025). Iranian early childhood dental caries: A comprehensive systematic review and meta-analysis of prevalence and associated risk factors. Evidence-Based Dentistry, 26(1), 66–66.
27. Jaganathan, S. K., Balaji, A., Vellayappan, M. V., Subramanian, A. P., John, A. A., Asokan, M. K., & Supriyanto, E. (2015). Review: Radiation-induced surface modification of polymers for biomaterial application. Journal of Materials Science, 50(5), 2007–2018. https://doi.org/10.1007/s10853-014-8718-x
28. Jainkittivong, A., & Langlais, R. P. (2005). Geographic Tongue: Clinical Characteristics of 188 Cases. The Journal of Contemporary Dental Practice, 6(1), 123–135. https://doi.org/10.5005/jcdp-6-1-123
29. Jurge, S., Kuffer, R., Scully, C., & Porter, S. (2006). Number VI Recurrent aphthous stomatitis. Oral Diseases, 12(1), 1–21. https://doi.org/10.1111/j.1601-0825.2005.01143.x
30. Klein, M. P. A., Aristizabal, M. M. A., Janovska, D. M., Bodiford, M. K. J., & Rogers III, M. R. S. (2026). The dermatologic oral examination: Navigating the oral dermatoses map. Journal of the American Academy of Dermatology, 94(5), 1413–1426.
31. Kleinman, D. V., Swango, P. A., & Niessen, L. C. (1991). Epidemiologic studies of oral mucosal conditions – methodologic issues. Community Dentistry and Oral Epidemiology, 19(3), 129–140. https://doi.org/10.1111/j.1600-0528.1991.tb00128.x
32. Lešić, S., Dukić, W., Šapro Kriste, Z., Tomičić, V., & Kadić, S. (2019). Caries prevalence among schoolchildren in urban and rural Croatia. https://repozitorij.unizg.hr/object/sfzg:2486
33. Majorana, A., Bardellini, E., Flocchini, P., Amadori, F., Conti, G., & Campus, G. (2010). Oral mucosal lesions in children from 0 to 12 years old: Ten years' experience. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 110(1), e13–e18.
34. Manfredini, M., Guida, S., Giovani, M., Lippolis, N., Spinas, E., Farnetani, F., Dattola, A., Di Matteo, E., Pellacani, G., & Giannetti, L. (2021). Recurrent aphthous stomatitis: Treatment and management. Dermatology Practical & Conceptual, 11(4), e2021099.
35. Miloğlu, Ö., Göregen, M., Akgül, H. M., & Acemoğlu, H. (2009). The prevalence and risk factors associated with benign migratory glossitis lesions in 7619 Turkish dental outpatients. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 107(2), e29–e33.
36. Neville, B. W., Damm, D. D., Allen, C. M., & Chi, A. C. (2016). Oral and maxillofacial pathology (Vol. 432). Elsevier St. Louis. https://forums.ohdsi.org/t/medication-related-osteonecrosis-of-the-jaw-dentistry-phenotype/21039
37. Organization, W. H. (2013). Oral health surveys: Basic methods. World Health Organization. https://books.google.com/books?hl=en&lr=&id=8rEXDAAAQBAJ&oi=fnd&pg=PP1&dq=24.%09World+Health+Organization.+Oral+health+surveys:+basic+methods.+5th+ed.+Geneva:+WHO%3B+2013.&ots=fELKT5vGXt&sig=AxA0zL_D7fn12ARBH0Id9fHKHmg
38. Owczarek-Drabińska, J. E., Nowak, P., Zimoląg-Dydak, M., & Radwan-Oczko, M. (2022). The prevalence of oral mucosa lesions in pediatric patients. International Journal of Environmental Research and Public Health, 19(18), 11277.
39. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. Bmj, 372. https://www.bmj.com/content/372/bmj.n71.short
40. PALATE, L. H. (2024). Clinical Pathologic Conference Cases Presented at the 22nd International Congress of Oral Pathology and Medicine, Cancún, México, June 18-22, 2024. https://www.researchgate.net/profile/Madhu-Shrestha/publication/394202593_Clinical_Pathologic_Conference_Case_6_An_ulcerated_lesion_on_the_gingiva_of_an_adolescent_female/links/69a67aab251850084d73fc5c/Clinical-Pathologic-Conference-Case-6-An-ulcerated-lesion-on-the-gingiva-of-an-adolescent-female.pdf
41. Parra-Moreno, F. J., Egido-Moreno, S., Schemel-Suárez, M., González-Navarro, B., Estrugo-Devesa, A., & López-López, J. (2022). Treatment of recurrent aphtous stomatitis: A systematic review. Medicina Oral, Patología Oral y Cirugía Bucal, 28(1), e87.

42. Picciani, B. L. S., Domingos, T. A., Teixeira-Souza, T., Santos, V. de C. B. dos, Gonzaga, H. F. de S., Cardoso-Oliveira, J., Gripp, A. C., Dias, E. P., & Carneiro, S. (2016). Geographic tongue and psoriasis: Clinical, histopathological, immunohistochemical and genetic correlation-a literature review. Anais Brasileiros de Dermatologia, 91(4), 410–421.
43. Pinna, R., Cocco, F., Campus, G., Conti, G., Milia, E., Sardella, A., & Cagetti, M. G. (2019). Genetic and developmental disorders of the oral mucosa: Epidemiology; molecular mechanisms; diagnostic criteria; management. Periodontology 2000, 80(1), 12–27. https://doi.org/10.1111/prd.12261
44. Piyarathne, N. S., Weerasekera, M. M., Fonseka, P. F. D., Karunatilleke, A. H. T. S., Liyanage, R. L. P. R., Jayasinghe, R. D., De Silva, K., Yasawardene, S., Gupta, E., & Jayasinghe, J. A. P. (2023). Salivary interleukin levels in oral squamous cell carcinoma and oral epithelial dysplasia: Findings from a Sri Lankan study. Cancers, 15(5), 1510.
45. Renert-Yuval, Y., & Guttman-Yassky, E. (2019). What's new in atopic dermatitis. Dermatologic Clinics, 37(2), 205–213.
46. Salwaji, S., Pasupuleti, M. K., Manyam, R., Pasupuleti, S., Uzunçıbuk, H., Russo, D., Cervino, G., Marrapodi, M. M., & Minervini, G. (2025). Innovative technologies for identifying oral potentially malignant disorders: A systematic review. Exploration of Medicine, 6, 1001315.
47. Scardueli, C. R., Oliveira, G. J., Silveira, C. B., Arcaro, C. A., Marcantonio, R. A. C., Spin-Neto, R., & Junior, E. M. (2017). Estrôncio não radioativo como suplemento da potencialização da formação óssea em defeitos de calvaria. Avaliação óssea e toxicológica. Brazilian Oral Research, 31(Suppl. 2), 78–78.
48. Scully, C., & Porter, S. (2008). Oral mucosal disease: Recurrent aphthous stomatitis. British Journal of Oral and Maxillofacial Surgery, 46(3), 198–206.
49. Shulman, J., & Carpenter, W. (2006). Prevalence and risk factors associated with geographic tongue among US adults. Oral Diseases, 12(4), 381–386. https://doi.org/10.1111/j.1601-0825.2005.01208.x
50. Shulman, J. D. (2005). Prevalence of oral mucosal lesions in children and youths in the USA. International Journal of Paediatric Dentistry, 15(2), 89–97. https://doi.org/10.1111/j.1365-263X.2005.00632.x
51. Ünür, M., Kayhan, K. B., Altop, M., Metin, Z. B., & Keskin, Y. (2015). The prevalence of oral mucosal lesions in children: A single center study. Journal of Istanbul University Faculty of Dentistry, 49(3), 29–38.
52. Vieira-Andrade, R. G., Martins-Júnior, P. A., Corrêa-Faria, P., Stella, P. E. M., Marinho, S. A., Marques, L. S., & Ramos-Jorge, M. L. (2013). Oral mucosal conditions in preschool children of low socioeconomic status: Prevalence and determinant factors. European Journal of Pediatrics, 172(5), 675–681. https://doi.org/10.1007/s00431-013-1950-6
53. Wells, G. A., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M., & Tugwell, P. (2000). The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. https://scholar.archive.org/work/zuw33wskgzf4bceqgi7opslsre/access/wayback/www3.med.unipmn.it/dispense_ebm/2009-2010/Corso%20Perfezionamento%20EBM_Faggiano/NOS_oxford.pdf
54. Yañez, M. S., Escobar, E., Oviedo, C., Stillfried, A., & Pennacchiotti, G. (2016). Prevalence of oral mucosal lesions in children. https://repositorio.udd.cl/items/03835eb7-29f7-4ef0-bd39-dbeddc85c3c1
55. Yao, H., Song, Q., Zhang, Q., Tang, G., & Liu, M. (2022). Prevalence of oral mucosal lesions in children in Xiangyun of Yunnan, China: A cross-sectional study. Italian Journal of Pediatrics, 48(1), 15. https://doi.org/10.1186/s13052-022-01209-6
56. Yilmaz, A. E., Gorpelioglu, C., Sarifakioglu, E., Dogan, D. G., Bilici, M., & Celik, N. (2011). Prevalence of oral mucosal lesions from birth to two years. Nigerian Journal of Clinical Practice, 14(3), 349–353.
57. Zhang, C., Li, B., Zeng, X., Hu, X., & Hua, H. (2023). The global prevalence of oral leukoplakia: A systematic review and meta-analysis from 1996 to 2022. BMC Oral Health, 23(1), 645. https://doi.org/10.1186/s12903-023-03342-y
58. Ziaei, H., Banan, S., & Alinejhad, D. (2022). Updates on Common Oral Diseases in Children. In Common Pediatric Diseases: An Updated Review (pp. 138–170). Bentham Science Publishers. https://www.benthamdirect.com/content/books/9789815039658.chap3 .