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Prevalence of lesions and alterations of the oral cavity in the Costa Rican population

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Prevalence of lesions and alterations of the oral cavity in the Costa Rican population
Prevalencia de lesiones y alteraciones de la cavidad bucal en la población costarricense

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Abstract: Introduction: To evaluate the prevalence and characteristics of diseases of the oral cavity in the Costa Rican population, including the clinical profile of affected patients. **Methodology**: A cross-sectional, descriptive, and quantitative study was conducted using medical records from patients diagnosed and treated at a Stomatology Center in Heredia, Costa Rica, between January 2020 and December 2022. Only cases with definitive diagnoses (clinical, histopathological, or radiographic) were included. Data were extracted from complete records, categorized by lesion type and anatomical location, and analyzed by sex and age group to identify frequency patterns. **Results**: A total of 1,410 patients were evaluated. The majority were women (62%) with 33.4% of cases in the 41–60 age group. Regarding men, the most affected group was 21–40 years. Traumatic lesions were the most frequent (33%), followed by benign neoplasms (11.1%) and potentially malignant disorders (10%). Fibrous hyperplasia was the most frequent lesion (n101), followed by squamous papilloma (n87), leukoplakia (n66) and squamous cell carcinoma (n55). Soft tissues were the most affected (80.5%), with the tongue being the most common site (23.4%), followed by the gingiva (21.5%) and the lips (13.7%). **Conclusions**: This study systematically classified and quantified oral lesions in a defined clinical population, generating the most comprehensive epidemiological dataset of its kind in Costa Rica. The findings offer extrapolatable data for academic research, clinical training, and public health policy, helping to improve early diagnosis, prevention strategies, and the management of oral conditions, especially those with malignant potential, across diverse sectors of the population.

Keywords: oral cancer; oral medicine; oral pathology.

Resumen: Introducción: Evaluar la prevalencia y las características de las enfermedades de la cavidad oral en la población costarricense, incluyendo el perfil clínico de los pacientes afectados. **Metodología**: Se realizó un estudio transversal, descriptivo y cuantitativo, utilizando los expedientes médicos de pacientes diagnosticados y tratados en un Centro de Estomatología en Heredia, Costa Rica, entre enero de 2020 y diciembre de 2022. Solo se incluyeron los casos con diagnósticos definitivos (clínicos, histopatológicos o radiológicos). Los datos se extrajeron de expedientes completos, se categorizaron según el tipo de lesión y la localización anatómica, y se analizaron por sexo y grupo etario para identificar patrones de frecuencia. **Resultados**: Se evaluaron un total de 1,410 pacientes. La mayoría fueron mujeres (62%), con el 33.4% de los casos en el grupo etario de 41 a 60 años. En los hombres, el grupo más afectado fue el de 21 a 40 años. Las lesiones traumáticas fueron las más frecuentes (33%), seguidas por las neoplasias benignas (11.1%) y los trastornos potencialmente malignos (10%). La hiperplasia fibrosa fue la lesión más común (n=101), seguida del papiloma escamoso (n=87), la leucoplasia (n=66) y el carcinoma escamoso (n=55). Los tejidos blandos fueron los más afectados (80.5%), siendo la lengua el sitio más común (23.4%), seguida de la encía (21.5%) y los labios (13.7%). **Conclusiones**: Este estudio clasificó y cuantificó sistemáticamente las lesiones orales en una población clínica definida, generando el conjunto de datos epidemiológicos más completo de su tipo en Costa Rica. Los hallazgos ofrecen información extrapolable para la investigación académica, la formación clínica y la formulación de políticas de salud pública, contribuyendo a mejorar el diagnóstico temprano, las estrategias de prevención y el manejo de las enfermedades orales, especialmente aquellas con potencial maligno, en diversos sectores de la población.

Palabras clave: cáncer bucal; medicina bucal; patología bucal.

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1. Introduction

Oral pathology and oral medicine are the most appropriate sciences to diagnose, treat and guide the different conditions and diseases of the oral cavity (Roy, 2016) . Worldwide, there are multiple advances and research related to specific diseases that develop in the mouth, such as oral cancer, salivary gland tumors, odontogenic tumors, among others. However, there are few geographical regional studies that attempt to characterize from an epidemiological point of view the wide variety of lesions capable of generating impact on the oral cavity (Alhindi et al., 2019; Mendez et al., 2012). Many of these investigations focus only on cases received in pathology laboratories, leaving out the enriching area of oral medicine and the clinical aspect of the disease (Ha et al., 2014).

Even more scarce is the literature and research in these areas aimed at the Costa Rican population, with publications associated with oral cancer or case reports of specific diseases, finding only one investigation developed in 2019 that counts and describes the cases diagnosed at the University of Costa Rica's oral pathology center (Boza Oreamuno & López Soto, 2019).

This problem forces us to understand and study oral pathology and oral medicine based on information developed by research focused on populations that may be far from the Costa Rican and Latin American reality (Alhindi et al., 2019; Jones & Franklin, 2006; Monteiro et al., 2021), generating an important bias not only in the training of students in dentistry and medicine, but also impacting clinical-scientific development, especially when considering prevention protocols, early diagnosis and treatment of oral diseases.

Therefore, the objective of this study is to establish, through a significant case study and an epidemiological perspective, the prevalence and frequency of the different diseases and conditions that affect the population of Costa Rica. All with the intention of generating concise and objective information that contributes to the advancement of research in these areas of health sciences, allowing students, doctors, dentists and researchers to have accurate and useful data, extrapolated to different sectors of Costa Rica.

2. Theoretical reference

Currently, and despite the great medical and technological advances available that clearly facilitate the diagnosis and treatment of the different conditions that affect the oral region, we are facing constant changes. The emergence of new diseases such as SARS-CoV-2, advanced ages, patients with chronic diseases resulting from new lifestyles, controlled with multiple medications that have the capacity to generate relevant side effects for the oral cavity, changes in sexual practices that allow infection of the oral cavity and oropharyngeal cavity by oncoviruses, such as some genotypes of the human papillomavirus, all of this represents a daily challenge for current oral medicine and pathology(McBride, 2017; Pemberton, 2017; Sheedy & Heaton, 2019; Soares et al., 2021).

Medical-scientific progress in the present has managed to identify a large number of diseases and alterations capable of affecting the oral and maxillofacial region, dividing them according to their etiopathogenesis, demonstrating how complex, but important, it is not only to have dominance in these areas, but also to continue with research to develop better prevention and treatment protocols.

Several studies have been carried out worldwide with the aim of determining the incidence and or prevalence of diseases and pathologies capable of affecting the oral cavity (Ali & Sundaram, 2012; Dhanuthai et al., 2018; Du et al., 2020; Mello et al., 2018). However, studies related to oral pathology and medicine in Costa Rica are scarce, with case reports being the most written research articles in the last 3 decades (Ana et al., 2009; Barrantes & González, 2009; Boza Oreamuno DDS, MSc, 2017; Gerber Mora et al., n.d., 2021; Gerber-Mora et al., 2015; Howard-Mora, 2010; Lao-Gallardo & Sobalvarro-Mojica, 2015b; Ramírez Chacón & Ramírez Chacón, 2016). We must also take into account that in the entire Costa Rican territory there are only 5 specialists who work in this area of dentistry (Miembros Especialistas | Colegio de Cirujanos Dentistas de Costa Rica, 2025). In Costa Rica and to date, only one article has been published with the aim of determining the frequency of pathologies treated in a university clinical care center, accounting for a total of 263 cases in a period of 7 years, with reactive pathologies, such as fibrous hyperplasia, being the most frequent (Boza Oreamuno & López Soto, 2019).

Regarding oral cancer, there are only two studies based on reports from the Costa Rican Ministry of Health, according to the National Tumor Registry database(Gallardo-Lao & Melendez Bolaños, 2001; Lao-Gallardo & Sobalvarro-Mojica, 2015a). One of the studies detailed 307 new cases of oral cancer diagnosed between 2006 and 2010, reporting a predilection for men over 65 years of age. Regarding the most frequent location in the oral cavity, the authors place the tongue as the anatomical site with the greatest predilection for the development of oral cancer; however, many sites are not specified, such as subdivisions of the tongue, gums, hard or soft palate, and cheeks. Concerning the possibly associated etiological factors, they are not reported at all (Lao-Gallardo & Sobalvarro-Mojica, 2015a). Since then, no reports or investigations have been conducted regarding oral cancer in Costa Rica, as of the date of this investigation.

3. Methodology

3.1 Approach

This is a cross-sectional, descriptive study with a quantitative approach, with the objective of determining the prevalence and classifying the different lesions diagnosed between January 2020 and December 2022, taking into account the population treated at an oral pathology and oral medicine center in Heredia, Costa Rica. Only cases that met the inclusion and exclusion criteria were used.

3.2 Study population

All patients treated at an oral pathology and oral medicine center, with a definitive diagnosis, whether clinically, histopathologically and/or imaging-based.

3.3 Inclusion and Exclusion criteria

Cases were included of patients in whom a definitive diagnosis was obtained either by histopathological, clinical or radiological means. Only patient files with complete and relevant data were considered for the investigation. Cases were excluded from records of patients without a definitive diagnosis, including those whose lesions were still under investigation at the time of data collection, or if their records were incomplete.

3.2 Collection techniques

Data were collected retrospectively from digital medical records of patients diagnosed and treated at the Stomatology Center in Heredia, Costa Rica, between January 2020 and December 2022. The dataset was curated by the principal investigator using a structured Excel spreadsheet that included predefined variables: age, sex, anatomical location of the lesion, and final diagnosis. A comprehensive checklist guided the data extraction process to ensure consistency and completeness. All entries were later reviewed by a second oral medicine specialist based in Brazil to validate data accuracy and reduce observer bias. Diagnoses were established through clinical, histopathological, and/or radiographic criteria, with many cases supported by biopsy or laboratory confirmation. Only cases that met all inclusion criteria and presented complete diagnostic information were considered. Incomplete or duplicate records were excluded. To maintain patient confidentiality, all identifying data were anonymized prior to analysis.

3.5 Analysis processing

After collecting all relevant information, the data was organized in an Excel table, classifying each pathology according to the following categorization (Table 1). Once the cases were ordered and classified, the mean age of all patients was obtained, both as a whole and by sex. In addition, the sample was divided into age groups to determine which of these groups were most associated with some alteration in the oral cavity, as well as to establish which pathologies were the most frequent (Table 2).

Table 1
Pathology classification

Reactive/traumatic lesions

Infectious diseases: bacterial, viral, fungal, parasitic

Autoimmune and immune-mediated diseases

Developmental disorders and alterations

Benign neoplasms

Malignant neoplasms

Odontogenic and non-odontogenic cysts

Oral potentially malignant disorders

Oral manifestations of systemic diseases and conditions

Within normal limits

Iatrogenic injuries

Table 2
Classification of the sample by age groups

0 - 20 years old

21 - 40 years old

41 - 60 years old

61 - 80 years old

81 - 100 years old

The anatomical regions that most frequently presented changes or lesions were also identified and were divided into two major categories: 1- Soft tissues and 2- Hard tissues. Soft tissues were subdivided into a- lip (skin, vermilion, and labial mucosa), b- buccal mucosa, c- retromolar triangle/retromolar region, d- alveolar mucosa/vestibule fundus, e- gingiva (papilla, attached, marginal, residual alveolar ridge), f- floor of mouth, g- hard palate, h- tongue (anterior two-thirds, dorsum, lateral borders, ventral, frenulum), i- oropharynx (base of tongue, soft palate, palatine tonsils), j- generalized oral mucosa (when the disorder multifocally affected the oral mucosa), k- extraoral, and l- unspecified region. The hard tissues were subdivided into the mandible: a- mandibular body, b- parasymphysis, c- internal angle, d- ascending ramus. Maxilla: a- anterior region (which includes the area between teeth 1.3 to 2.3 and the premaxilla), b- posterior region (which includes from the premolars to the maxillary tuberosity and the palatine bone), c- maxillary sinus

and d- unspecified region. Once all the files with their respective information were obtained, the different types of lesions were determined in number and percentage.

Exploratory data analysis was performed using absolute and relative frequencies (percentages), as well as cross-tabulations by age group, sex, lesion type, and anatomical location. Microsoft Excel was used for the organization and analysis of data, including the construction of bar charts and pie charts to facilitate visual interpretation of the findings.

4. Results

During the study period, a total of 1,481 patients were included, however, 71 records were discarded because they did not meet the inclusion criteria. Of the remaining 1,410 records, 876 were female patients, representing 62% of the entire sample. Regarding age, patients were seen between 2 and 93 years of age, with an overall mean age of 44.9 years of age. The average age of women was 47.5 years of age, while the average age of men was 42.4 years of age.

 In relation to women, the most affected age group was 41 to 60 years of age (33.4%), followed by the group of patients between 21 and 40 years of age (26.7%). Regarding men, the most common age group was 21 to 40 years of age (36%), followed by the group from 41 to 60 years of age (29.4%).

The distribution of demographic characteristics in this Costa Rican cohort (62% female; mean age of 44.9 years) aligns with trends observed in several Latin American and different regions of the world (United Kingdom, Brazil, Peru, Poland, Australia), that the incidence of diseases and conditions affecting the oral cavity occurs more frequently in the female population (Alhindi et al., 2019; Amaral et al., 2016; Arruda et al., 2021; Boza Oreamuno & López Soto, 2019; Jones & Franklin, 2006; Radwan-Oczko et al., 2022; Volkweis et al., 2010). However, and unlike similar studies, in the male population the age group most affected by some condition was between 21 and 40 years, that is, the highest prevalence occurred in patients under 40 years, while in other investigations a higher frequency was reported in patients over 40 years (Ali et al., 2013; Amaral et al., 2016).

Of the total of 1,410 patients, 1,421 disorders or diseases were diagnosed, as some patients had more than one lesion. As expected, the most frequent lesions were represented in the group of reactive/traumatic lesions, with a total of 510 cases, corresponding to 36% of the total lesions diagnosed, coinciding also with what was reported by other investigations (Mendez et al. 2012; Alhindi et al. 2019). Benign neoplasms were the second most common group, with 158 cases (11.1%), results similar to comparable studies (Jones and Franklin 2006). Table 3 summarizes the remaining groups and their respective percentages.

Table 3

Categorization of the different lesions and changes that affected the oral cavity

	Number of cases	Percentage
Reactive/traumatic lesions	510	36%
Benign neoplasms	158	11.1%
Oral potentially malignant disorders	141	10%
Infectious diseases	116	8.1%
Odontogenic and non-odontogenic cysts	114	8%
Developmental disorders and alterations	105	7.2%
Autoimmune and immune-mediated diseases	99	7%
Malignant neoplasms	64	4.5%
Within normal limits	55	4%
Iatrogenic injuries	37	3%
Oral manifestations of systemic diseases and conditions	22	1.5%
Total	1421	100%

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In the reactive/traumatic lesions group, fibrous hyperplasia totaled 101 cases, followed by periapical granuloma (n50) and mucocele (n47). Detailed breakdowns by anatomical region are provided in Appendix A (Table A1). Benign neoplasms totaled 158 cases, with oral squamous papilloma being the most frequent with 87 cases, followed by odontoma (n15), pleomorphic adenoma/myoepithelioma, lipoma, and nevi with 7 cases each. Consistent with findings from other studies (Volkweis et al., 2010; Liceaga Escalera et al., 2022), benign tumors were more common than malignant ones in the present investigation, Table A1 also shows malignant neoplasms, with a total of 64 cases, where squamous cell carcinoma represents 86% of all cancers in this investigation, which aligns with global research highlighting its predominance in this category (Mendez et al., 2012).

The third group is represented by oral potentially malignant disorders, with a total of 141 cases (10%). Of these, the most common lesion was oral leukoplakia, corresponding to 46.8%, followed by oral lichen planus (27%) and proliferative verrucous leukoplakia (10.6%) (Table A1). Similar to a previous study conducted in Costa Rica, which also highlights that these conditions frequent and critical (Boza Oreamuno and López Soto 2019). Interestingly, a study conducted in India found that potentially malignant diseases were the most common condition, led by oral submucous fibrosis (Rohini, Sherlin, and Jayaraj 2020). This demonstrates the importance of each region maintaining records and case counts, as research results from other geographic regions are sometimes not comparable or applicable. For example, a similar study conducted in Kuwait did not report potentially malignant diseases (Ali and Sundaram 2012).

When potentially malignant oral disorders were analyzed by sex and age group, we found that these conditions were more frequent among women in the Costa Rican population, particularly across four age groups: 21–40, 41–60, 61–80, and 81–100 years. This contrasts with findings from other studies, such as Kumar et al. (2019), where men are generally reported to be more affected (Table 4).

Among the infectious diseases, bacterial infections accounted for a total of 53 cases, with periapical/periodontal abscess being the most frequent (27), followed by osteomyelitis and infections associated with *Treponema pallidum* (Table A1). The group of viral infections accounted for a total of 48 cases, with lesions associated with human papillomavirus (condyloma acuminatum, common wart, multifocal epithelial hyperplasia) being the most frequent in this group (n29). Infections associated with fungi were the least frequent, representing only 6% of all infectious diseases. It is interesting to compare these results with other similar investigations, taking into account that one study reported a low incidence of only 1.31% of infectious lesions (Liceaga Escalera et al. 2022).

In contrast, several studies have emphasized the prominence of fungal infections, particularly those associated with *Candida albicans*, which have been reported as the third most common diagnosis globally across all lesion groups (Radwan-Oczko et al., 2022). Another investigation found candidiasis to be the second most frequent lesion after fibrous hyperplasia, while also noting that viral infections account for just 2.1% of all cases (Amaral et al., 2016).

Cysts (odontogenic and non-odontogenic) registered for 114 cases. Odontogenic keratocyst was the most common cyst in this investigation, accounting for 25 cases corresponding to 22% of all cysts, followed by dentigerous cyst (19.3%) and periapical inflammatory cyst (16.6%) (Table A1). This finding contrasts with global literature, where the most frequently reported cyst is the inflammatory radicular cyst, followed by the dentigerous cyst (Monteiro et al., 2021). The discrepancy may be due to the fact that many periapical and pericoronal cystic lesions are not being submitted for histopathological analysis by surgeons.

The sixth most frequent group was represented by developmental disorders and alterations, headed by vascular malformations and varicosities, totaling 34 cases (32.4%), followed by cemento-osseous dysplasia (n15) and exostoses/torus (n14). Autoimmune and immune-mediated diseases represented an overall percentage of 7%, with a total of 99 cases, the most frequent being recurrent aphthous stomatitis with 27 cases, benign migratory glossitis (n21) and mucous membrane pemphigoid (n16) (Table A1).

Patients with normal anatomical structures represented 4% of the total cases. Iatrogenic lesions totaled 37 cases, with drug-induced stomatitis being the most common (n13), representing 35% of this group, followed by 11 cases of amalgam tattooing (29.9%). Finally, we have oral manifestations of systemic diseases and conditions with 22 cases in total, among them lupus, anemia, amyloidosis and hypothyroidism (Table A1).

Interestingly, classifying the lesions by sex and age group yielded different data. Table 4 summarizes the 5 most frequent lesions divided by age group and sex. For example, in the female age group between 0 and 20 years, the most common lesion was mucocele, followed by lesions associated with the human papillomavirus (HPV). On the other hand, for the same age group, but in men, benign neoplasias were the most frequent, followed by developmental odontogenic cysts.

For women aged 21 to 40, benign neoplasias were the most frequent lesions. In contrast, in men, HPV-associated lesions were the most frequent. In the 41 to 60 age group, HPV-associated lesions were the most frequent in men. On the other hand, fibrous hyperplasia was the most frequent alteration in women in this age group.

In the 61-80 age group, potentially malignant disorders and malignant neoplasms were the most frequent in both men and women. The same was true for the 81-100 age group. Interestingly, and with the exception of men aged 81-100, HPV-associated lesions were among the 5 most frequent pathologies in the remaining age groups, both in women and men.

While national and regional retrospective studies generally support broader trends, such as the predominance of reactive and fibrous hyperplasias in women, the peak incidence of HPV-associated lesions in men, and the increasing prevalence of malignant pathologies in the elderly; the specific lesion distribution by sex and age group observed in this study, including the prominence of cysts and benign neoplasms in particular youth age-sex categories, has not been mirrored in the literature from 2000 onward. This dataset provides a unique contribution due to its detailed granularity, rendering it both rare and exceptionally valuable for advancing the field.

Continuing with the classification corresponding to the anatomical region, the lesions and changes that affected the soft tissues represented 80.5% of the total cases in this investigation. The tongue was the most affected anatomical region (23.4%), followed by the gum (21.5%) and the lips (13.7%). Then we have the generalized oral mucosa (10.3%), buccal mucosa (7%), retromolar trigone/retromolar region (3%), alveolar mucosa/vestibule fundus (2.5%), floor of the mouth (3.7%), hard palate (6.2%) and oropharynx (6.8%). These results match precisely with the three most commonly affected anatomical regions reported in a previous study conducted in Costa Rica (Boza Oreamuno & López Soto, 2019). However, studies from other parts of the world show significant variation in the anatomical distribution of oral lesions (Ali et al., 2013; Amaral et al., 2016; Arruda et al., 2021).

Cases associated with hard tissues accounted for only 19.5%, with the mandible being the most affected anatomical region with almost half of the reported cases in this area (49%), followed by the maxilla (34.7%), maxillary sinus (4%) and unspecified regions (12.1%). Among all hard tissue regions involved, the mandibular body showed the highest number of changes with 36.1%, followed by the anterior region of the maxilla (21.7%).

Table 4

Most frequent lesions/disorders by age group - comparison between men and women

Age group	Female	Male
0-20	Mucocele (N19)	Bening neoplasms (N11)
	HPV associated lesions (N7)	DOC (N10)
	Benign neoplasms (N6)	Mucocele (N8)
	RAS (N5)	HPV associated lesions (N7)
	MMO (N5)	Vascular malformations (N5)
21-40	Benign neoplasms (N16)	HPV associated lesions (N24)
	Fibrous hyperplasia (N15)	Mucocele (N14)
	OPMD (N12)	DOC (N12)
	HPV associated lesions (N12)	Fibrous hyperplasia (N10)
	Pyogenic granuloma (N10)	Benign neoplasms (N8)
41-60	Fibrous hyperplasia (N32)	HPV associated lesions (N23)
	HPV associated lesions (N20)	OPMD (N20)
	OPMD (N19)	Fibrous hyperplasia (N13)
	Oral lichen planus (N11)	Malignant neoplasms (N10)
	Pemphigus/pemphigoid (N9)	DOC (N6)
61-80	OMPD (N27)	Malignant neoplasms (N11)
	Malignant neoplasms (N18)	OPMD (N8)
	Fibrous hyperplasia (N18)	Fibrous hyperplasia (N7)
	HPV associated lesions (N17)	HPV associated lesions (N6)
	Oral lichen planus (N13)	DOC (N6)
81-100	OPMD (N9)	Malignant neoplasms (N4)
	Malignant neoplasms (N7)	OPMD (N1)
	HPV associated lesions (N4)	Iron deficiency anemia (N1)
	Fibrous hyperplasia (N2)	Pyogenic granuloma (N1)
	Epulis fissuratum (N2)	Chronic traumatic ulcer (N1)
N-number. HPV-human papillomavirus. RAS-recurrent aphthous stomatitis. MMO-morsicatio mucosae oris. OPMD-potentially malignant oral disorders. DOC-developmental odontogenic cysts.		
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5. Conclusions

This study represents one of the most comprehensive epidemiological investigations of oral cavity diseases ever conducted in Costa Rica. Through the analysis of 1,410 cases over a three-year period, we were able to classify and quantify the full spectrum of oral lesions encountered in clinical oral pathology and medicine, highlighting not only their frequency but also their demographic and anatomical distribution.

The findings underscore the predominance of reactive/traumatic lesions, particularly fibrous hyperplasia, as well as the relevance of benign neoplasms and potentially malignant disorders in the Costa Rican population. The tongue, gingiva, and lips emerged as the most frequently affected anatomical regions, mirroring local data while differing in some aspects from global trends.

Notably, the lesion distribution by age group and sex revealed unique epidemiological patterns, including the unexpectedly high prevalence of HPV-associated lesions among men in younger and middle-aged groups, the predominance of benign neoplasms in young women, and the significant presence of malignant and potentially malignant disorders. These patterns were not reflected in comparable literature published since 2000, suggesting that the granularity and demographic specificity of this dataset are both novel and of high value for regional and international comparisons.

This study reveals a remarkably high frequency of oral potentially malignant disorders in the Costa Rican population. These conditions represented a significant share of the total diagnosed lesions and were not confined to older adults, as traditionally expected. In fact, a meaningful proportion was found in patients under 60, especially in those between 41–60 years of age, emphasizing a shifting epidemiological trend that challenges previous assumptions about age-related risk. The stratified analysis by age group provides novel insight into the demographic reach of these lesions and underscores the importance of early detection strategies not just for the elderly, but for middle-aged adults as well. These findings contribute valuable regional evidence and call for heightened clinical awareness and preventive public health measures.

Despite the extent of this study, several limitations must be acknowledged when considering the generalizability of the results to the entire Costa Rican population. Firstly, the data were obtained from a single specialized stomatology center in Heredia, which, although comprehensive and methodologically rigorous, represents a convenience clinical population rather than a randomized or nationally distributed sample. As such, certain population segments, especially rural, low-income, or indigenous communities with limited access to specialized care, may be underrepresented, potentially tilting the overall prevalence and distribution patterns of oral lesions.

Although the sample size is the largest of its kind in Costa Rica, extrapolation to national prevalence must be approached cautiously. The absence of similar multicenter or population-based studies limits direct comparison or validation across diverse regions of the country.

Therefore, while the findings offer a rich epidemiological profile that is valuable for academic and clinical purposes, future multicentric studies, including rural clinics and public health institutions, are essential to capture the full epidemiological panorama of oral diseases in Costa Rica and to ensure that underserved populations are not left unrepresented in oral health research and policy development.

By fulfilling its objective, this study provides concise and relevant data that contribute meaningfully to the advancement of oral health research in Costa Rica. The results have the potential to inform the training of dental and medical professionals, guide public health policy, and strengthen early

detection and prevention strategies for oral diseases, including those with malignant potential. Continued research, public education, and institutional investment are essential to building on these findings and improving oral health outcomes throughout the region.

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