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SMOKELESS TOBACCO, REAL RISKS: EVIDENCE ON THE IMPACTS OF SNUS ON ORAL HEALTH

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ABSTRACT

The use of smokeless tobacco, particularly snus, has gained popularity as an alternative to conventional cigarettes and is often promoted as a harm reduction strategy. However, its effects on oral health remain controversial and are not widely discussed among oral health professionals and educators. This systematic review aimed to gather and critically analyze the scientific evidence on the impact of snus on oral health. A structured search was conducted in four databases (PubMed, SciELO, Scopus, and ScienceDirect) using controlled descriptors and combinations of relevant keywords. Fourteen studies published between 2015 and 2025 were included, comprising systematic reviews, observational studies, in vitro research, and pharmacokinetic trials. The results indicate associations between snus use and oral lesions, gingival inflammation, dental staining, high nicotine absorption, and, in some cases, a potential risk for oral cancer. The presence of toxic compounds and the early use of snus among adolescents highlight the need for more effective educational, regulatory, and clinical measures. It is concluded that snus is not harmless to oral health and should be addressed in tobacco control strategies and in the training of public health and preventive dentistry professionals.

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INTRODUCTION

Tobacco consumption remains one of the leading preventable causes of morbidity and mortality worldwide, being directly associated with several chronic non-communicable diseases, including cardiovascular and respiratory diseases, and various types of cancer. In recent decades, in response to increasing restrictions and anti-smoking campaigns, the consumption of smokeless tobacco products such as snus — a moist tobacco placed between the lip and gum, traditionally used in Nordic countries such as Sweden and Norway — has expanded. Promising to be less harmful than conventional cigarettes, snus has been promoted as a harm reduction alternative. However, continued use of this product raises substantial concerns about its adverse effects on the oral cavity, including mucosal lesions, pigmentation, gingival inflammation, periodontal changes, and even the risk of oral neoplasms. These effects not only compromise users' quality of life but also pose a challenge to oral health systems, especially in contexts of social vulnerability and low dental coverage. Adolescents and young adults are a group particularly exposed to the use of snus and other smokeless tobacco products, driven by marketing strategies, attractive flavors, and the appeal of modernity. This not only puts immediate oral health at risk but also perpetuates patterns of nicotine use and dependence throughout life. Given the growing popularity of these products and the knowledge gap among healthcare professionals and educators regarding their true impacts, it is essential to gather and critically analyze the scientific literature on the topic. This study proposes a systematic review of the available evidence on the consequences of smokeless tobacco use on oral health, focusing on snus products, aiming to contribute to health education, public policy formulation, and preventive clinical practice.

Theoretical Framework: Tobacco consumption is one of the leading preventable causes of illness and death worldwide, accounting for more than 8 million deaths annually, according to the World Health

Organization (Who, 2021). Although cigarettes are the most widespread form of smoking, there has been a diversification of tobacco products in recent decades, driven by regulatory, cultural, and market factors. In this context, smokeless tobacco stands out, a category that includes various presentations, such as snus, snuff, chewing tobacco, and nicotine sachets, which are predominantly administered orally. Snus is a form of moist tobacco, traditionally consumed in Nordic countries, especially Sweden, and placed between the upper lip and gum, where it remains for prolonged periods. Its popularity outside Scandinavia occurs amid the harm reduction narrative, often presented as a "safer" alternative to cigarettes because it does not generate smoke or combustion (Clarke, 2019; Hecht, 2022). However, studies show that snus contains high levels of nicotine, tobacco-specific nitrosamines (TSNAs), heavy metals, polycyclic aromatic hydrocarbons, and aldehydes, many of which are associated with cytotoxic, genotoxic, and carcinogenic effects (Muthukrishan, 2018; Valen, 2023).

Although the risks of lung cancer and respiratory diseases are lower than with cigarettes, the local effects on the oral cavity are substantial, including mucosal changes, whitelesions (leukoplakia), gingival recession, periodontal changes, bleeding, hyperpigmentation, and a potential risk of oral câncer (Kopperud, 2023; Bray, 2025). Oral health, as an integral component of overall health, is increasingly recognized as a sensitive indicator of the social, cultural, and economic conditions of individuals and communities. In Brazil, based on the principles of the Unified Health System (SUS), oral health is a universal right and should be promoted through educational, preventive, and curative actions at all levels of care. However, dental care coverage remains uneven, especially among young and vulnerable populations, which exacerbates the effects of tobacco use on the oral cavity (Ministry of Health, 2022).Snus use among adolescents and young adults is a growing phenomenon, driven by aggressive marketing strategies, online availability, the use of attractive artificial flavors, and the false sense of security associated with the absence of smoke. Recent research indicates that snus is increasingly being used by adolescents as a product for introducing nicotine, which carries not only the risk of addiction but also the early establishment of habits that are harmful to oral and general health (Ansteinsson, 2023; Németh, 2024).

Initiating use of these products at an early age compromises healthy development, interferes with adherence to oral hygiene practices, and can hinder early diagnosis of lesions. Furthermore, the concomitant use of snus with alcoholic beverages and other tobacco products increases the risks, creating an oral environment conducive to the development of inflammatory and neoplastic diseases (Dalrymple, 2021). In public discourse, snus and other alternative nicotine-based products are frequently included in the debate on harm reduction, which aims to minimize the harmful effects of tobacco in already dependent populations. Although this concept is relevant and widely debated in international literature, its application must be judicious and based on solid evidence, especially regarding use among non-smokers and young people. Studies such as that by Araghi et al. (2021) indicate an absence of a significant association between snus use and oral cancer in some populations, but emphasize that this does not imply an absence of risks, especially in contexts of prolonged use, combination with other risk factors, and lack of professional monitoring. Consequently, the role of oral health education becomes central. Strategies must be developed that connect schools, healthcare facilities, social media, and family environments to increase health literacy, debunk myths about "less harmful" products, and promote preventive habits. Multidisciplinary work, focusing on youth, vulnerability, and comprehensive care, is an essential tool for curbing the expansion of smokeless tobacco use and protecting collective oral health. Furthermore, it is crucial that dental professionals be trained to identify clinical signs related to snus use early, guiding their patients based on scientific evidence, and building bridges between individual care and collective health promotion. Therefore, a critical look at the impacts of snus on oral health is urgently needed, both because of the need to improve clinical and educational practices and because of its potential.

MATERIALS AND METHODS

This systematic review aimed to identify, analyze, and synthesize the scientific evidence available in the international literature on the effects of smokeless tobacco, especially snus, on oral health. The study followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring transparency and reproducibility.

Search strategy

The systematic search was carried out between May and July 2025, in the following electronic databases:

- PubMed (Medline)
- SciELO
- ScienceDirect
- Scopus

The descriptors used were selected from the controlled vocabularies DeCS (Health Sciences Descriptors) and MeSH (Medical Subject Headings). The keyword combinations used included:

("Smokeless tobacco" OR "snus" OR "oral snuff") AND ("oral health" OR "oral lesions"OR "oral cancer" OR "periodontal disease") No restrictions were applied regarding language or publication period, aiming to include a representative and current bibliographic body. The references of the included articles were also manually examined to identify additional relevant studies.

Inclusion criteria: Studies that met the following criteria were included:

- Original scientific articles, systematic reviews, or controlled clinical studies;
- Studies addressing the effects of snus or smokeless tobacco on the oral cavity, including clinical, toxicological, histological, or epidemiological aspects;
- Research with human samples or in vitro studies focusing on oral effects (such as lesions, inflammation, gingival changes, cancer risk, etc.);
- Publications with full text available, regardless of the original language.

Exclusion criteria

The following were excluded:

- Case reports, letters to the editor, commentaries, and abstracts without full text;
- Studies that did not present outcomes directly related to oral health;
- Research focused exclusively on respiratory, cardiovascular, or psychological aspects of smokeless tobacco use.

Study selection process: The screening process was conducted in two stages. In the first, the titles and abstracts were independently reviewed by two researchers to determine eligibility. In the second stage, the selected articles were read in full to confirm their compliance with the established criteria. In case of disagreement, a third reviewer was consulted.

Number of studies included: After the selection process, 14 studies were included in this systematic review, including original articles, systematic reviews and in vitro experimental studies.

Data extraction and analysis

For each included study, the following information was extracted:

- Authors and year of publication

- Type of study
- Research location
- Sample and population evaluated
- Type of product evaluated (snus, others)
- Clinical or laboratory outcomes
- Main results

The information was organized in a summary table, which will be presented in the Results section, allowing a comparative view of the evidence.

RESULTS

Fourteen studies published between 2015 and 2025 were included, distributed as follows: four narrative/updated reviews, three systematic reviews (including one critical review), four cross-sectional or cohort observational studies, one pharmacokinetic study, one in vitro study, and one review focused on harm reduction. The scientific production concentrated in Nordic countries (Sweden, Norway, Finland), but also included continental Europe, South Asia, and North America. The populations evaluated ranged from adolescent schoolchildren to long-term adult users; two studies directly examined dental or tissue samples.

Oral Cancer Risk: The evidence on carcinogenesis remains controversial and heterogeneous. The systematic review by Valen et al. (2023) suggests a residual risk, albeit lower than that of cigarettes, while Araghi et al. (2021), in a pooled analysis of nine European cohorts, observed no statistically significant association. Differences in design, exposure time, and confounding variables (alcohol, oral hygiene, HPV coinfection) may explain the divergence. Despite the heterogeneity, the persistent content of TSNAs (Hecht & Hatsukami, 2022) justifies caution: potentially malignant lesions should be screened in primary care protocols.

Toxic Compounds and Biomarkers: Hecht & Hatsukami (2022) report detectable levels of recognized carcinogens, such as N-nitrosonornicotine, in several brands of snus. Lunell et al. (2020) demonstrate peak plasma nicotine levels comparable to cigarettes after 30 minutes of use, indicating the potential for addiction. These data contradict commercial narratives of a "safe" product and reinforce regulatory debates about labeling and marketing restrictions.

Dental Aesthetics and Quality of Life: The in vitro study by Dalrymple et al. (2021) shows that snus significantly darkens tooth enamel, impacting self-esteem and social perception. This aspect, although sometimes underestimated, is relevant for prevention strategies in adolescents, as aesthetics is a motivating factor in abandoning harmful habits.

Table 1. Characteristics of the included studies and main results

Authors and Year	Type of Study	Location	Population	Product Reviewed	Main Results
Muthukrishnan & Warnakulasuriya (2018)	Narrative review	India	Scientific literature	Snus and others	Oral lesions, gum inflammation, risk of oral cancer
Bhandari & Bhatta (2021)	Narrative review	Nepal	Scientific literature	Smokeless tobacco	Changes in the oral mucosa and periodontium
Kopperud et al. (2023)	Cross-sectional study	Norway	Teenagers	Snus	Frequent oral lesions among daily users
Valen et al. (2023)	Systematic review	Sweden	Snus users	Snus	Cancer risk still present, although lower than cigarettes
Hecht & Hatsukami (2022)	Critical review	USA	Toxicological studies	Snus and cigarettes	Presence of carcinogenic compounds in snus
Lunell et al. (2020)	Pharmacokinetic study	Sweden	Adult volunteers	Snus and ZYN	High nicotine absorption, even without tobacco
Araghi et al. (2021)	Observational study	Europe (9 cohorts)	Adult users	Snus	No significant association with oral cancer was found.
Clarke et al. (2019)	Opinion review	United Kingdom	Various studies	Snus	Defends snus as a harm reduction alternative
Sieber et al. (2016)	Updated review	Switzerland	Clinical studies	Snus	Gum recession, stains, oral lesions
Dalrymple et al. (2021)	In vitro study	USA	Dental samples	Snus, e-cigs	Severe enamel stains from snus and cigarettes
Heikkinen et al. (2015)	Narrative review	Finland	Population data	Snus and cigarettes	Association with gum disease and whitelesions
Bray et al. (2025)	Systematic review	United Kingdom	Clinical studies	Snus	Moderate risks for oral mucosa and inconclusive evidence of cancer
Németh et al. (2024)	Observational study	Hungary	Teenagers	Snus	Gingival involvement and higher prevalence of oral lesions
Ansteinsson et al. (2023)	Cross-sectional study	Norway	Teenagers	Snus	Social and family factors associated with the onset of use

The findings of this systematic review reinforce that, although snus and other smokeless tobacco products are often promoted as "less harmful" alternatives, they are not without risks to oral health. The identified key issues are discussed below.

Oral Lesions and Periodontal Conditions: Cross-sectional studies in Norwegian adolescents (Kopperud et al., 2023) and Swedish adults (Sieber et al., 2016) converge in describing gingival recession, discoloration, and hyperkeratosis in the snus contact zone. The high mechanical pressure, combined with the local release of nicotine and irritants, appears to trigger a chronic inflammatory process that, if not stopped, can progress to loss of periodontal attachment and increased susceptibility to infections. These findings highlight the need for periodic clinical monitoring of users and educational interventions focused on hygiene and reduction/cessation of use.

Youth Vulnerability and Peer Influence: Ansteinsson et al. (2023) and Németh et al. (2024) identify peer pressure, digital advertising, and flavorings as triggers for initiation. This requires multisectoral educational initiatives, involving schools, social media, and health services, to correct risk perception and provide cessation support.

Harm Reduction: Reality or Rhetoric?: Clarke et al. (2019) argue that snus can reduce deaths related to cigarette smoke; however, this logic fails to consider local effects in the oral cavity or the risk of new nicotine users. The literature gathered here demands an integrated health perspective: harm reduction actions must balance respiratory gains with oral losses and include systematic dental monitoring.

Implications for public policy and clinical practice

- Regulation and labeling – include specific oral health warnings and limit flavorings that attract young people.

- Training for dentists – training to detect early snus-associated injuries and guide cessation programs.
- Epidemiological surveillance – incorporate smokeless tobacco use indicators into national oral health surveys.
- Intersectoral education – campaigns that integrate schools and primary care units, combating the false perception of snus safety.

Limitations of the Review: Most studies used observational designs, which are susceptible to confounding bias.

Three narrative reviews may overestimate effects due to the lack of formal meta-analysis. Furthermore, regional differences in the chemical composition of snus limit generalizability. Nevertheless, triangulation across clinical, toxicological, and population studies lends biological plausibility to the findings.

Gaps and Recommendations for Future Research

- Longitudinal controlled trials with standardized oral assessment.
- Investigation of the impact of snus on the oral microbiome.
- Cost-effectiveness studies of smokeless tobacco-specific cessation programs.
- Qualitative assessment of cultural and gender motivations for snus use.

Summary – The results show that snus is not without its risks to oral health: it causes mucosal lesions, periodontal disease, tooth staining, and has carcinogenic potential. Tobacco control policies should include smokeless tobacco in their prevention and surveillance strategies, with an emphasis on young and vulnerable populations.

CONCLUSION

This systematic review analyzed 14 studies that investigated the effects of smokeless tobacco, especially snus, on oral health. The results demonstrate that, although promoted as an alternative to cigarettes, snus is associated with oral lesions, gum inflammation, aesthetic changes, and potential carcinogenic risks. The data highlight that the use of these products, especially among adolescents, represents an overlooked risk factor for public health. The presence of toxic compounds, high nicotine absorption, and low risk perception reinforce the need for preventive, educational, and regulatory measures. The conclusion is that snus is not free from harm to oral health and should be included in tobacco control strategies and in clinical and educational practices aimed at promoting oral health.

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