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REVIEW

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The impact of stress on oral health. Literature review

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Objetivos: Recognize how psychological stress can affect oral health, identifying how stressors can influence the onset, progression, and manifestation of oral diseases, as well as the physiological mechanisms involved in these processes. The analysis aims to provide relevant information for healthcare professionals in order to improve the diagnosis, treatment, and prevention of oral pathologies related to stress, adopting a comprehensive and holistic approach to dental care. **Materiales y Métodos:** To conduct this literature review, a search was carried out for scientific articles such as literature reviews, Mendelian randomization studies, case series, cross-sectional studies, and longitudinal studies in different scientific search engines such as PubMed, Scielo, and Google Scholar. The inclusion criteria were articles published from 2015 to the present year in English and Spanish that directly addressed the research question and were consistent with the review's objective. The exclusion criteria were studies conducted before 2015, studies that did not address the central topic of the review, articles with restricted access, and studies with results not relevant to the research question.

Conclusión: This literature review shows how stress affects oral health in many ways, leading to a poor lifestyle and causing adverse effects on the oral cavity and all the human organism.

PALABRAS CLAVE

Stress, Oral Health, Adverse Effects

1 | INTRODUCCIÓN

Stress is the body's response to a real or perceived threat that affects the organism's homeostasis. Several systems in the body are involved in the stress response, such as the endocrine, nervous, and immune systems, triggering various physiological reactions. The system primarily responsible for this response is the endocrine system, which releases the hormone cortisol, regulated by the hypothalamic-pituitary-adrenal (HPA) axis[1].

Two neuroendocrine systems are involved in the stress response: the sympathetic-adrenal-medullary (SAM) system and the hypothalamic-pituitary-adrenal (HPA) axis. When facing a stressful situation, the SAM system mediates the initial response, which releases catecholamines (adrenaline, norepinephrine, and small amounts of dopamine). This process is followed by the activation of the HPA axis, where the hypothalamus and anterior pituitary are activated to secrete corticotropin-releasing hormone (CRH) and produce adrenocorticotropic hormone (ACTH)[1]. These processes stimulate the zona fasciculata of the adrenal cortex to release glucocorticoids into the bloodstream, with cortisol being the primary glucocorticoid in humans. The release of this hormone is the characteristic marker of the HPA axis response to a stressful situation. Cortisol increases gluconeogenesis, which leads to the suppression of proper immune system function. This is why stress can affect both psychological well-being and physical health[1, 2].

Psychological stress can be caused by various factors, such as social, personal, and academic issues, among others, which can affect oral health, manifesting in different ways within the oral cavity[3]. A person experiencing stress may exhibit changes in their habits and behaviors, leading to alterations in several physiological processes within the oral cavity, such as a weakened immune response, reduced saliva flow, and changes in the inflammatory response. Due to these changes, susceptibility to the development of oral diseases or the progression of existing conditions increases. Stress has been linked to various oral pathologies[4, 5].

Healthcare professionals need to recognize how stress can manifest in the oral cavity. This allows healthcare providers to take a more holistic approach to dental care. Understanding how stress affects oral health provides valuable information for making an accurate diagnosis, treatment, or prevention plan. It is important to note that oral manifestations can reflect a person's overall psychological state. The objective of this study is to recognize how psychological stress can affect oral health, identifying how stressors can influence the onset, progression, and manifestation of oral diseases, as well as the physiological mechanisms involved in these processes.

2 | MATERIALES Y MÉTODOS

To conduct this literature review, a search was carried out for scientific articles such as literature reviews, Mendelian randomization studies, case series, cross-sectional studies, and longitudinal studies in different scientific search engines such as PubMed, Scielo, and Google Scholar. The keywords used for the literature search were Çorrelation Between,Stress,Relationship,Xerostomia,Oral Lichen Planus, Bruxism,Periodontal Disease,.ªnd Çovid-19 Stress". These keywords helped identify relevant studies on the relationship between stress and various oral health conditions. The inclusion criteria were articles published in English and Spanish from 2015 to the present year that directly addressed the research question and were consistent with the review's objective. The exclusion criteria were studies conducted before 2015, studies that did not address the central topic of the review, articles with restricted access, and studies with results not relevant to the research question.

3 | STATE OF THE ART

Stress is a mechanism of the body that generates a response to situations of threat. It is essential to understand that stress can be helpful in moments that require an immediate reaction to a stimulus in order to ensure survival and well-being. However, when stress becomes prolonged or chronic, it can have negative effects on both mental and physical health [1]. Currently, humans are exposed to elevated levels of stress, and this condition continues to increase over time, becoming a health problem with greater incidence each year,

especially in industrialized countries[6]. This condition is perceived differently in men and women, being women who experience it more frequently. Due to the physiological changes caused by this condition, various health issues can arise, one of which affects the oral cavity, causing oral diseases. Oral diseases have a multifactorial origin. Biological and host factors, such as stress, can predispose adverse effects on the oral cavity, affecting it in multiple aspects[6, 7, 8].

Stress stimulates an unhealthy oral cavity, encouraging a patient to adopt a poor diet and sedentary conduct, and potentially leads to the consumption of alcohol, tobacco, illicit drug use, etc. Long-term stress would lead to an increased allostatic load, which could induce an imbalance in the physiological system's function necessary for preserving homeostasis. Consequently, this would impact the mechanisms of disease progression[9, 10].

Currently, there is no standard stress measurement, but subjective, objective, and physiological/biomedical tools can be used. The choice of measurement depends on whether the stress being studied is acute or chronic. Interviews and questionnaires are the primary tools for assessing self-perceived and environmental stress. On the other hand, physiological measurements and biomarkers are used to quantify physiological or chronic stress, that is, to measure the physiological response triggered by stress[11].

3.0.1 | Xerostomia and Dental cavities

Xerostomia is a disease where the mouth is dry; it occurs when there's a decrease or absence of saliva production, causing taste alterations. Stress is a psychological factor that will induce the elevation of cortisol, leading to imbalanced cytokines that could develop oral autoimmune diseases. Additionally, this would lead to speaking and eating difficulties, as well as a lack of oral hygiene. It has been found that stress causes salivary changes, which would produce susceptibility to dental caries. Dental cavities produced by a lack of oral hygiene can also lead to toothache[11, 12, 13, 14, 15].

The analyzed cross-sectional studies confirmed a correlation between stress and xerostomia, as well as low salivary flow in patients. It is worth noting that this condition was more prevalent in patients with severe levels of stress[14, 16, 17, 18].

Additionally, xerostomia would cause discomfort and a deterioration in the overall quality of life. Moreover, it is known that a patient who consumes psychotropic drugs will also show a salivary flow decrease. Lastly, besides reducing salivary flow, it also disrupts pH, inducing the eruption of different lesions[19]. The absence of saliva boosts the formation of uncommon forms of dental decay, including decays at incisal, cervical, or cusp tips and radicular lesions[4, 8, 18, 20].

3.0.2 | Bruxism

Bruxism is unconscious tooth grinding that usually causes constant jaw parafunction, such as Temporomandibular Joint (TMJ) pain, TMJ noise, limited opening pathway, masticatory muscle pain, and tooth attrition, but these affections are not always present in all bruxism cases[21, 22, 23, 24]. Around 10 % to 20 % of the population is affected by bruxism. This pathology can cause chronic and constant trauma in the stomatognathic system. It has been seen that its prevalence is relevant in patients between ages 20 and 50 years old[25, 26].

Bruxism may affect kids or adults and can be perceived day or night. It is a multifactorial origin pathology. Stress provokes this condition, causing many adverse effects. Some people claim headaches and articular, dental, and mandibular pain, but it may also present itself as asymptomatic. This pathology can alter the quality of sleep. Not to mention masticatory muscle hypertrophy is also presented[25, 26, 27].

Bruxism patients are also found to have fractured teeth, exostoses, tooth sensibility, and dental wear. Stress produces muscle contractions, causing pain in the neck, head, and masticatory muscles, such as the temporal and masseter muscles. The orofacial system is compromised, and excess muscle activity induces hypotonia, meaning muscle weakness [28].

This pathology can lead to problems with dental prosthetics, as well as a general fatigue sensation and tiredness. Elevated levels of stress increase the likelihood of bruxism by almost six times. Teeth grinding could cause overactivity of the chewing muscles, leading

to overwork in these muscles, vasoconstriction, and ischemia. And with ischemia, some harmful chemicals such as prostaglandins and bradykinin are released, causing muscle pain[22, 23, 25].

According to cross-sectional studies analyzed for this investigation, there is a significant correlation between patients who experience stress daily and the presence of bruxism; There is no significant gender difference in the prevalence of bruxism[22, 23, 24, 26, 29, 30, 31, 32]. Bruxism is classified into two types: sleep bruxism and awake bruxism. The latter, awake bruxism, is the more prevalent form, and in most cases, it is found in patients who report high levels of stress[23, 24, 29, 30]. On the other hand, sleep bruxism is more prevalent in childhood and young adulthood, and this condition tends to decrease with age[29, 32, 33].

Additionally, the correlation between bruxism and temporomandibular joint disorder caused by stress induces higher problems such as pain, restricted mouth opening, TMJ noise, unusual opening pattern, displaced articular disc, and osteoarthritis. Studies have shown that patients with bruxism tend to exhibit depression, stress, and anxiety, meaning they develop issues with social interactions and are more likely to have psychosomatic disorders[22, 23, 26, 27, 29].

3.0.3 | Periodontal disease

When a person experiences chronic stress, a cascade of physiological responses is triggered. The hypothalamus releases corticotropin-releasing hormone (CRH), which activates the hypothalamic-pituitary-adrenal (HPA) axis. This, in turn, prompts the pituitary gland to secrete adrenocorticotropic hormone (ACTH), stimulating the adrenal glands to produce cortisol[1, 2]. Cortisol, a key stress hormone, has a suppressive effect on immune function. It inhibits the activity of various immune cells, including macrophages, eosinophils, neutrophils, and mast cells, which play essential roles in inflammation and immune defense. As a result, chronic stress can lead to dysregulation of the immune system, impairing both immune responses and inflammatory processes. This explains why prolonged stress is associated with immune suppression and increased vulnerability to infections and inflammatory conditions[10].

Periodontal disease is an inflammatory condition leading to the progressive destruction of the periodontal complex's soft and hard tissues. It often begins with an imbalance in the oral microbiota, which triggers an immune-inflammatory response. At this stage, the host's immune system plays a crucial role in defending against the disease and controlling its progression[34, 35]. Given this, stress can disrupt the immune response, potentially contributing to the onset and accelerated progression of periodontal disease[34]. A cross-sectional study demonstrated that individuals exposed to chronic stress have a 16 % to 38 % higher prevalence of periodontal disease compared to those not exposed to this condition[36]. Stress leads to a suppressed immune system response and a reduced salivary flow, and the combination of both would cause the accumulation and the rapid proliferation of bacteria in plaque in the oral cavity, especially the Porphyromonas gingivalis, one of the most prevalent bacteria present in periodontal disease[36, 37, 38, 39]. The constant presence of bacteria in dental plaque leads to ongoing production of proinflammatory cytokines, resulting in significant tissue damage; this is shown on the alveolar bone and periodontal ligament as well[38, 39].

Moreover, stress plays a significant role in accelerating the advancement of necrotizing periodontal disease. This condition manifests through symptoms such as ulceration of the gingival interdental papilla, bleeding, and pain[9]. Stress prompts unhealthy dietary habits, including the consumption of foods high in sugar and fat; it also contributes to poor oral hygiene practices, such as smoking, excessive alcohol consumption, and infrequent dental visits[9, 39].

According to the meta-analysis and cross-sectional studies analyzed for this investigation, a strong relationship is demonstrated between stress and periodontal disease; it is essential to know that stress is one of many factors that contribute to the onset and progression of this disease, also demonstrated that periodontal pathology is more prevalent in middle-aged people and older adults as well[10, 34, 35, 36, 39, 40, 41].

3.0.4 | Oral Lichen Planus (OLP)

Oral lichen Planus is a chronic autoimmune inflammatory disease triggered by a type IV hypersensitivity reaction to an antigenic alteration affecting the oral mucosa[42, 43]. The pathogenic mechanism is still unknown, but some local, environmental, and genetic factors may contribute to the activation of the host immunological system[43]. The causes of this activation are not clear but are related to dental materials, drugs, infectious agents, allergies, habits, and stress[44, 45, 46, 47]. Psychological Stress affects the adaptive immune system; these alterations are first mediated by a neuroendocrine mediator from the HPA and sympathetic axes; this results in immune dysregulation, which triggers the production of proinflammatory cytokines and activates both the immune and inflammatory responses[42, 47, 48].

Oral Liquen Planus is characterized by white, velvety, gray, thread-like papules arranged in a linear, mesh, or ring-like pattern, forming lacy patches, streaks, and rings[44, 45]. A small dot is raised, and white appears where the white lines intersect, called Wickham´s striae[46]. These lesions are asymptomatic and appear symmetrical on both sides of the mouth. Commonly it appears on the cheek lining, lips, palate, tongue, gums, and floor of the mouth. Oral Liquen Planus has six common types: erosive, reticular, atrophic, papular, bullous, and plaque-like[44, 45, 46].

According to case-series studies, stress plays a crucial role as a risk factor in the development of Oral Liquen Plano[42]. Epidemiologic, literature review and metanalysis studies analyzed have demonstrated that stress is essential to developing OLP[43, 44, 47, 48, 49]. Furthermore, patients who have this condition are more prone to developing psychological conditions; this condition is more prevalent in female patients[43, 45, 48]. Is essential to note that stress is just one of the several factors that could develop OLP[43, 44, 45, 46, 47, 48].

3.0.5 | Covid-19 stress impact on oral health

COVID-19 has significantly impacted mental health. Stress is a factor that has increased in this period. It's been demonstrated that pandemic stress has developed bruxism, leading to periodontal disease in patients. Additionally, it has led to aphthoid ulcers and herpetic recurrences. These oral ulcers affect patients' eating, swallowing, and talking.[50] COVID-19 stress has been linked to the secondary type of herpetic gingivostomatitis, which leads to lip blisters, skin rashes, and desquamative gingivitis. Patients have also claimed to have inflammation of tongue papillae, inducing ulcers and macules, producing discomfort when they ingest food[51].

According to a meta-analysis, stress can influence how individuals perceive their self-care needs and impact their motivation to engage in daily routines[52, 53, 54]. In the studies reviewed, stress induced by COVID-19 has been linked to a state of immunosuppression, which can trigger or exacerbate various oral health conditions[35]. For example, stress has been shown to activate the Herpes Simplex Virus, contribute to bruxism, and lead to an increase in dental cavities, partly due to higher consumption of sugary foods as a coping mechanism for stress[52, 54, 55, 56].

A study suggested that parents' stress due to COVID-19 has affected children's oral health. Parenting could be slightly modified, such as children's hygiene habits leading to increased gingival and dental diseases[57, 58]. The consumption of medicines to manage Covid-19 has led to xerostomia. Additionally, the functioning of salivary glands may change because of the presence of the SARS-CoV-2 virus, resulting in xerostomia[57, 58].

4 | DISCUSIÓN

Stress is the body's response to a perceived threat, mediated by the HPA (hypothalamic-pituitary-adrenal) axis[1]. This system triggers the release of cortisol, a hormone that promotes gluconeogenesis, increasing blood sugar levels[1, 2]. While this response is essential for immediate survival, prolonged cortisol elevation can suppress the immune system, leading to various health issues[1, 2, 3]. This brief explanation highlights how stress can affect humans' physiological and psychological well-being[1, 2, 3].

Stress negatively affects oral health due to immune system suppression[1, 6, 8, 15]. This results in the development and rapid progres-

sion of various conditions, such as dental caries, xerostomia, bruxism, temporomandibular joint disorders, lichen planus, and periodontal disease[7, 8, 59]. The recent emergence of COVID-19 and its impact on both mental and physical health has played a significant role in the deterioration of oral health[13, 25, 58, 60].

According to studies, it is clear that stress is one of the several factors that can trigger oral diseases, though it is not the only cause[22, 25, 28, 42, 59, 61]. Oral health issues typically arise when multiple factors combine, but it is important to note that stress plays a primary role [10, 22, 38, 59]. All the studies analyzed agree that stress affects oral health due to its impact on the proper functioning of the immune system. However, other factors were also identified, such as neglect and a decline in oral hygiene habits, increased consumption of sugary foods, and the use of alcohol and tobacco[3, 9, 19].

The studies most commonly quantified stress using the Perceived Stress Scale (PSS), which is one of the most validated tools with psychometric solid properties[1, 18, 24, 29, 31, 41, 44**?**]. The PSS consists of 14 items that assess stress based on the frequency of complex events over the past month. There are also two shorter versions of the scale, PSS-4 and PSS-10[10].

Most studies have demonstrated that individuals who experience high levels of stress are more susceptible to developing various health issues. For instance, Aoki J et al. found that individuals who experience higher stress levels were 8.7 times more likely to develop oral health problems[15]. Similarly, the study by Arman K et al. showed that participants who reported elevated stress levels were more likely to suffer from bruxism[20]. Additionally, research by Vlădutu D et al. indicated that participants who reported experiencing "very much.ºr .exˢtensively"high levels of stress were significantly more prone to bruxism and temporomandibular joint (TMJ) disorders[23]. Furthermore, the study by Macri M et al. demonstrated that patients with higher stress levels exhibited a 15–36 % greater incidence of periodontal problems[40].

On the other hand, several studies have evaluated the potential differences between sexes and found no significant differences. For example, studies by Fluerașu M et al., Phuong N et al., Saczuk K et al., and Cavallo P et al. confirmed that bruxism did not vary by sex[22, 24, 30, 31]. However, the study by Vlădutu D et al. found that women had a higher prevalence of .ªwake bruxism"[23].

In the case of stress-related xerostomía and periodontitis, no discrepancies were found, as this condition was observed equally in both men and women[14, 17, 34, 36, 38, 39, 41, 58, 61, 62, 63, 64]. In contrast, studies have shown that the disease known as lichen planus is more commonly experienced by female patients. For example, studies by Adamo E et al., Li K et al., Mahmud M, and Radwan M et al. have highlighted this higher prevalence in women[43, 44, 48, 65]. This may be due to hormonal and genetic factors, which cause them to react differently than men[66, 67].

As we have seen in this study, stress is an essential factor in the onset and progression of the oral diseases mentioned earlier. Therefore, patients experiencing chronic stress must receive holistic treatment. In addition to being treated by a psychologist and physician, they should receive care from a dentist to ensure a better quality of life. This comprehensive approach should improve their health, habits, and mental well-being.

For future research, it is critical to refine the methods used to assess stress levels more reliably. For example, measuring cortisol levels in saliva could provide a more accurate and objective stress assessment. Additionally, further studies are needed to understand why specific individuals are more susceptible to stress-related oral health issues, which could lead to more tailored and effective treatments. Identifying these factors may also help in developing preventive strategies to reduce or halt the progression of stress-related oral diseases.

5 | CONCLUSIONS

This literature review showed how stress affects oral health in many ways, leading to a poor lifestyle and causing adverse effects on the oral cavity and the entire health system. The pathologies stress can cause bruxism, xerostomia, periodontal disease, dental caries, temporomandibular joint disorder, lousy hygiene, less salivary flow, xerostomia, oral herpes, etc. Covid-19 outcome has also hugely affected oral health due to the stress it has put on people, causing bruxism, ulcers, and deficient hygiene. Innovative healthcare strategies now prioritize the reduction of stress levels in patients because managing stress is essential for having good oral health.

The evidence suggests that stress is a primary, but not sole, trigger for oral diseases. It often interacts with other factors to the onset and progression of pathologies in the oral cavity. Studies using the Perceived Stress Scale (PSS) consistently show that high-stress levels correlate with a greater incidence of oral health issues, including bruxism and periodontal disease. However, the impact of stress on oral health appears to be consistent across genders for conditions like xerostomia and periodontitis, though some conditions, such as Oral Lichen Planus, are more prevalent in women, possibly due to hormonal or genetic factors.

Given the clear link between stress and oral health, a holistic treatment approach is essential for patients with chronic stress. This should include care from both mental health professionals and dentists to improve patients' overall well-being.

Through this research, we have gained a better understanding of the repercussions that stress has on oral health. This knowledge is crucial for effectively addressing stress-related oral conditions, both in terms of treatment and prevention. While this article has not proposed specific treatment solutions, the evidence suggests that by better understanding the effects of stress, we can develop more comprehensive approaches to prevent and mitigate the progression of these diseases. Given the clear link between stress and oral health, it is essential to adopt a holistic approach to treating patients with chronic stress, one that includes care from both mental health professionals and dentists, to improve overall well-being and reduce the impact of these conditions on their quality of life.

6 | FINANCING

None

7 | CONFLICT OF INTERESTS

The author claims there's no conflict of interest.

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