The Impact of Diabetes and Psycho-Emotional State on Oral Health

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Abstract

Background: Diabetes is considered to be a global problem and its correlation with stress have a negative effect on oral health.
Aim: The purpose of the research is to determine how the combination of diabetes and stress affects oral health.
Methods: Various scientific databases have been used including "Pubmed", "ScienceDirect" and "Scopus". Diabetes, stress, cortisol and oral cavity diseases have been used as key words and the period from 2020 to 2024 has been defined.
Results: More than 100 articles have been searched for and forty of those have thoroughly been analyzed. Reference materials indicate that patients, who suffer from diabetes, are mostly affected by Periodontal disease and its consequences, caries and others. Additionally, the course of diseases can be exacerbated by stress as higher levels of released cortisol result in deteriorated immunity.
Conclusions: Based on perused sources of information the combination of diabetes and stress contributes to insulin resistance and has a detrimental effect on oral health. In order to prevent oral diseases from exacerbating and ensure relevant treatment, it is pivotal to diagnose and eliminate any contributing factor. **(TCM-GMJ August 2025; 10 (2): P22-P25)**

Keywords: Type 2 Diabetes, stress, oral health.

Introduction

Diabetes mellitus is a metabolic disorder having been plaguing global health for decades. It is also viewed as an epidemic due to its prevalence and dire consequences (1). The prevalence of diabetes is especially high in low and middle-income countries. According to the 2021 database, there were 537 million diabetics and an estimated number of sufferers is predicted to rise to 643 million by 2030 (2). 95 % of diabetic patients are affected by type 2 diabetes (3).

In recent decades, several risk factors have been identified in the development and progression of oral diseases, age, gender, socio-economic status, diabetes and stress amongst others (4) (5)(6)(7). The combination of diabetes and stress has a negative impact on either a person's general or oral health. And as it is revealed from the research, stress is more pronounced in patients with diabetes than in healthy individuals (8)(9). Stress affects human health both directly, through biological pathways involving neuroendocrine and autonomic processes and indirectly, through changes in behavior and habits. The perception and response to stressful situations are primarily carried out by the brain. With the help of cortisol and other mediators of allostasis, the body undergoes adaptation. However, when the regulation of these allostatic mediators is disrupted, it leads to an allostatic load, which in turn contributes to the progression of diseases.

Stress response, which maintains allostasis, consists of a cascade of adaptive reactions. On one hand, during acute stress, the sympathetic-adrenal-medullary (SAM) system is activated, resulting in the release of adrenaline and noradrenaline. On the other hand, the hypothalamic-pituitary-adrenal (HPA) axis is also activated. Under stress, corticotropin-releasing factor (CRF) is initially released, which stimulates the production of adrenocorticotropic hormone (ACTH), followed by cortisol or corticosterone. Negative feedback from the brain to glucocorticoids is manifested through the inhibition of stress responses. The effect of glucocorticoids,specifically cortisol on the brain is mediated through two main receptors: the glucocorticoid receptor (GR) and the mineralocorticoid receptor (MR)(10).

The impact of stress on the oral cavity is manifested in different ways. On the one hand, patients tend to adopt a range of bad habits, make changes in their diet and exhibit unsatisfactory oral hygiene. On the other hand, while un-

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dergoing stress, there are inevitable changes in the immune system which further affect oral health(11). Repeated exposure to stressful conditions over time may lead to dysregulation of the HPA axis and affect energy homeostasis and eating behavior(12). Chronic activation of the HPA axis can alter glucose metabolism, which influences insulin resistance, as well as multiple appetite-related hormones and hypothalamic neuropeptides. Norepinephrine and corticotropin-releasing factor (CRF) may suppress appetite during stress, whereas cortisol tends to stimulate appetite during the recovery phase of the stress response (13). Stress and emotional states influence eating behavior. Higher levels of perceived stress are associated with increased consumption of unhealthy foods. In stress research, different types of stressors are also distinguished, as they affect eating styles in different ways. For example, work-related, ego-threatening, and interpersonal stressors are more often linked to increased snack intake, compared to stressors that evoke physical fear. Intake of unhealthy food activates dopamine and opioid systems. Stress amplifies this effect, making the brain's reward pathways more sensitive, which can intensify cravings and compulsive behaviors (14). During stress, neglect of oral hygiene and the consumption of certain types of food, specifically carbohydrate-rich and soft foods are common manifestations that contribute to the accumulation of dental plaque on tooth surfaces and the elevation of interleukin-1β levels in crevicular fluid (15) . The production of large amounts of cortisol during stress leads to inhibition of neutrophil activity, Ig G and Ig A secretion in saliva, which increases the risk of developing destructive changes by periodontopathogens.

Given that people with diabetes have impaired insulin secretion and / or have trouble moving actively, the associated stress worsens hyperglycemia levels in blood (16). Hyperglycemia in the periodontal tissue increases the accumulation of AGEs, worsens the periodontal inflammatory processes, causes destructive changes and represents the risk of tooth loss (17). Periodontal disease affects up to 50% of the world's population and ranks second among the complications of diabetes (18). Periodontitis is considered one of the main factors of tooth loss. A number of problems are associated with tooth loss, such as difficulty in chewing, aesthetic discomfort and social isolation. All this has a profound impact on people's quality of life (19) (20).

It is noteworthy that the prevalence of edentulism is higher in diabetic patients than in healthy patients (21) Diabetes also affects the functioning of the salivary glands, which is manifested by dysfunction, decreased saliva secretion and changes in its content. During hyperglycemia, the glucose content in saliva increases and the oral microflora changes (22)(23)(24).

Studies also show that the high content of glucose in saliva in the oral cavity and hyposalivation is conducive to the growth of cariogenic bacteria and increases the risk of caries and the development of various oral diseases (25) (26)(27)(28). Among oral diseases, the prevalence of dental caries is also high in patients with diabetes. Research has shown that the DMFT index is higher in individuals with diabetes compared to healthy patients. However, a significant difference is observed between uncontrolled and controlled diabetes(29).

A literature review shows the relationship between diabetes, stress and oral diseases. Cortisol secretion during stress is a contributing factor to insulin resistance and its correlation with diabetes worsens glycemic control and triggers the development of oral diseases.

Results and discussion

Among the oral manifestations of diabetes mellitus, periodontitis and dental caries are among the most widespread conditions (30). Inflammatory responses, altered microbial flora, and changes in the composition and content of saliva under hyperglycemic conditions play a significant role in the bidirectional relationship between diabetes and periodontitis.

Proinflammatory mediators—cytokines such as IL-1β and TNF-α—contribute to insulin resistance and alter glucose utilization in patients with diabetes. Moreover, products released by periodontopathogens in periodontal tissues enter the systemic circulation, triggering a cascade of inflammatory responses in distant organs, including the pancreas, thereby further worsening glycemic control (31).Studies confirm that the treatment of periodontitis through scaling and root planing has a positive effect on metabolic control and reduces systemic inflammatory responses in patients with diabetes. (Huihui Zhang et al.) (32) In patients with uncontrolled type 2 diabetes, hyperglycemia alters not only salivary secretion and buffering capacity (Kaushalya Indunil Dharmakeerthi et al.), but also increases glucose levels in gingival crevicular fluid (Faris Saleh A. Alqazlan et al.), creating an optimal environment for periodontopathogenic bacteria(33)(34)(35). Products released by microbes, such as lipopolysaccharides (LPS), activate neutrophils and lead to the recruitment of macrophages, B cells, and T cells. Macrophage-derived Prostaglandin E2 (PGE2) and the T and B cell–mediated increase in Receptor Activator of Nuclear Factor-kappa B (RANK) stimulate osteoclasts, triggering destructive processes in bone.

Furthermore, PGE2 and neutrophil-induced matrix metalloproteinases (MMPs) contribute to the degradation of collagen fibers and the disruption of the junctional epithelium (36).

Patients with uncontrolled type 2 diabetes are at a significantly higher risk of developing periodontitis compared to those with well-controlled diabetes. The combination of stress and diabetes also affects salivary secretion (Hugo et al) and periodontitis health (Varshini, Rajasekar and Coelho et al) (37)(38). Stress, directly or indirectly, is one of the provoking factors in the development of oral diseases and as research shows there is a strong link between periodontal stress and diabetes (39). Untreated periodontitis in turn leads to tooth loss and complete or partial edentulism develops (Sagana M). Studies by Ikimi et al. and Taboza et al. reveal that patients with diabetes exhibit a higher number of missing teeth and elevated glycemic levels compared to non-diabetic individuals. Furthermore, research indi-

cates that complete edentulism is primarily observed in patients over the age of 60 (Emami et al.), and 55% of these patients are male (Hosseini et al.)(20) .

Salivary analysis in patients with type 2 diabetes has also shown a significantly higher presence of Streptococcus mutans in the oral cavity. Additionally, patient age and duration of diabetes were found to have a notable impact on the increase of Lactobacillus species. In patients with FBG > 200 mg/dL, salivary analysis revealed a lower pH level (Elkafri et al.)(26). Research shows that patients with uncontrolled type 2 diabetes exhibit poorer oral health conditions compared to healthy individuals, with stress acting as a contributing factor in the progression of these conditions (22)(40).

In diabetes, the risk of caries spreading is also high, which is caused by the increase in glucose levels in saliva and changes in the oral microflora (Puttaswamy et al)(26). Pacheco et al. studied the content of saliva and the amount of secretion in diabetic and healthy patients, as a result of which it was revealed that saliva secretion and calcium concentration are changed during type 2 diabetes, which affects the development and spread of caries (23). Untreated caries and periodontal diseases are provoking tooth loss, which has a negative impact on people's quality of life (22)(40) .

Conclusion

The interaction between psycho-emotional state and uncontrolled type 2 diabetes, along with the resulting physiological changes, contributes to alterations in the oral microbiota, salivary secretion, and oral pH levels. These changes promote the development of various oral diseases, and neglecting these conditions can lead to complications associated with tooth loss. Functional, psychological and social barriers that develop after tooth loss have a negative impact on people's quality of life. Most patients are not aware of the relationship between general and oral health, and it is pivotal e to increase awareness of this problem.

References

1. Global diabetes epidemic reaches critical levels with 800 million cases | UN News [Internet]. [cited 2025 May 31]. Available from: https://news.un.org/en/story/2024/11/1156971
2. WHO EMRO | World Diabetes Day 2024 | News | Media centre [Internet]. [cited 2025 May 31]. Available from: https://www.emro.who.int/media/news/world-diabetes-day-2024.html
3. Diabetes [Internet]. [cited 2025 May 31]. Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes
4. Eshete A, Mohammed S, Deresse T, Kifleyohans T, Assefa Y. Association of stress management behavior and diabetic self-care practice among diabetes type II patients in North Shoa Zone: a cross-sectional study. BMC Health Serv Res [Internet]. 2023 Dec 1 [cited 2025 May 31];23(1):1–7. Available from: s12913-023-09752-6
5. Arubaku W, Tusubira D, Ssedyabane F, Chamut S, Seymour BA, Siedner MJ, et al. Prevalence, correlates and treatment needs of dental caries in patients attending a diabetic clinic in rural southwestern Uganda: a cross-sectional study. BMC Oral Health [Internet]. 2023 Dec 1 [cited 2025 May 31];23(1):1–9. Available from: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-023-03156-y
6. Wu CZ, Yuan YH, Liu HH, Li SS, Zhang BW, Chen W, et al. Epidemiologic relationship between periodontitis and type 2 diabetes mellitus. BMC Oral Health [Internet]. 2020 Jul 11 [cited 2025 May 31];20(1):1–15. Available from: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-020-01180-w
7. Asiri A, Nazir MA, Alsharief M, Shahin S, Al-Ansari A, Al-Khalifa KS. Effect of psychological distress on oral health: a cross-sectional study. BMC Oral Health [Internet]. 2024 Dec 1 [cited 2025 May 31];24(1):1–8. Available from: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-024-05319-x
8. Siddharthan G, Reddy M, Sunil B. "Perceived stress" and its associated factors among diabetic patients receiving care from a rural tertiary health care center in South India. J Educ Health Promot [Internet]. 2021 Jan 1 [cited 2025 May 31];10(1):11. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7933676/
9. Jeong J, Jeong W, Jung Y. Association Between Self-Perceived Oral Health, Stress, and Oral Symptoms in South Korean University Students: A Cross-Sectional Study. Healthc 2025, Vol 13, Page 984 [Internet]. 2025 Apr 24 [cited 2025 May 31];13(9):984. Available from: https://www.mdpi.com/2227-9032/13/9/984/htm
10. McEwen BS, Akil H. Revisiting the Stress Concept: Implications for Affective Disorders. J Neurosci [Internet]. 2020 Jan 2 [cited 2025 May 31];40(1):12. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6939488/
11. Hill D, Conner M, Clancy F, Moss R, Wilding S, Bristow M, et al. Stress and eating behaviours in healthy adults: a systematic review and meta-analysis. Health Psychol Rev [Internet]. 2022 Apr 3 [cited 2025 May 31];16(2):280–304. Available from: https://www.tandfonline.com/doi/pdf/10.1080/17437199.2021.1923406
12. Cascino G, Chami R, Monteleone P. The Hypothalamus-Pituitary-Adrenal Axis and Eating Disorders. Eat Disord [Internet]. 2023 [cited 2025 May 31];1–12. Available from: https://link.springer.com/referenceworkentry/10.1007/978-3-030-97416-9_47-1
13. Janssen JAMJL. New Insights into the Role of Insulin and Hypothalamic-Pituitary-Adrenal (HPA) Axis in the Metabolic Syndrome. Int J Mol Sci 2022, Vol 23, Page 8178 [Internet]. 2022 Jul 25 [cited 2025 May 31];23(15):8178. Available from: https://www.mdpi.com/1422-0067/23/15/8178/htm
14. Yau YHC, Potenza MN. Stress and Eating Behaviors. Minerva Endocrinol [Internet]. 2013 Sep [cited 2025 May 31];38(3):255. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4214609/
15. Gunepin M, Derache F, Trousselard M, Salsou B, Risso JJ. Impact of chronic stress on periodontal health. J Oral Med Oral Surg [Internet]. 2018 Jan 1 [cited 2025 May 31];24(1):44–50. Available from: https://www.jomos.org/articles/mbcb/full_html/2018/01/mbcb160058/mbcb160058.html
16. Vedantam D, Poman DS, Motwani L, Asif N, Patel A, Anne KK. Stress-Induced Hyperglycemia: Consequences and Management. Cureus [Internet]. 2022 Jul 10 [cited 2025 May 31];14(7):e26714. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9360912/
17. Ahmadinia AR, Rahebi D, Mohammadi M, Ghelichi-Ghojogh M, Jafari A, Esmaielzadeh F, et al. Association between type 2 diabetes (T2D) and tooth loss: a systematic review and meta-analysis. BMC Endocr Disord [Internet]. 2022 Dec 1 [cited 2025 May 31];22(1):100. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9006550/
18. Păunică I, Giurgiu M, Dumitriu AS, Păunică S, Pantea Stoian AM, Martu MA, et al. The Bidirectional Relationship between Periodontal Disease and Diabetes Mellitus—A Review. Diagnostics 2023, Vol 13, Page 681 [Internet]. 2023 Feb 11 [cited 2025 May 31];13(4):681. Available from: https://www.mdpi.com/2075-4418/13/4/681/htm
19. Neethu SS, Manjunath PP, Yashoda R. Association of social network and social support with oral health among institutionalized elderly: A cross-sectional study in Bangalore city. Clin Epidemiol Glob Heal [Internet]. 2023 Nov 1 [cited 2025 May 31];24:101439. Available from: https://www.sciencedirect.com/science/article/pii/S2213398423002269
20. M S, Duraisamy R, M J. Correlation Between Diabetes and Completely Edentulous Condition-A Retrospective Study. J Res Med Dent Sci [Internet]. 2020 Oct 26 [cited 2025 May 31];0(0):163–7. Available from: https://www.jrmds.in/articles/correlation-between-diabetes-and-completely-edentulous-conditiona-retrospective-study-59277.html
21. Ahmadinia AR, Rahebi D, Mohammadi M, Ghelichi-Ghojogh M, Jafari A, Esmaielzadeh F, et al. Association between type 2 diabetes (T2D) and tooth loss: a systematic review and meta-analysis. BMC Endocr Disord [Internet]. 2022 Dec 1 [cited 2025 May 31];22(1):1–20. Available from: https://bmcendocrdisord.biomedcentral.com/articles/10.1186/s12902-022-01012-8
22. Jacob L, Shin J Il, Oh H, López-Sánchez GF, Smith L, Haro JM, et al. Association between diabetes and edentulism and their joint effects on health status in 40 low and middle-income countries. BMJ Open Diabetes Res Care [Internet]. 2021 Oct 7 [cited 2025 May 31];9(1):e002514. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8499266/
23. Anuradha G, Swathi K V., Arvind M. Salivary glucose as an alternative reliable marker in diabetes mellitus: A systematic review. Biomed. 2023 May 4;43(2):559–66.
24. Machado V, Botelho J, Proença L, Alves R, Oliveira MJ, Amaro L, et al. Periodontal status, perceived stress, diabetes mellitus and oral hygiene care on quality of life: A structural equation modelling analysis. BMC Oral Health [Internet]. 2020 Aug 20 [cited 2025 May 31];20(1):1–11. Available from: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-020-

01219-y
25. Zhou G, Shu X, Long Y, Cao Y, Wang J, Liao G, et al. Dental caries and salivary alterations in patients with type 2 diabetes: A systematic review and meta-analysis. J Dent [Internet]. 2024 Nov 1 [cited 2025 May 31];150:105321. Available from: https://www.sciencedirect.com/science/article/pii/S0300571224004901
26. Almusawi MA, Gosadi I, Abidia R, Almasawi M, Alrashood ST, Ekhzaimy A, et al. Association between salivary factors and cariogenic bacteria in type-2 diabetes patients. J King Saud Univ - Sci [Internet]. 2020 Jul 1 [cited 2025 May 31];32(5):2617–21. Available from: https://www.sciencedirect.com/science/article/pii/S1018364720301695?via%3Dihub
27. Agarwal J, Pandey P, Saxena SK, Kumar S. Comparative analysis of salivary microbiota in diabetic and non-diabetic individuals of North India using metagenomics. J Oral Biol Craniofacial Res [Internet]. 2024 Jan 1 [cited 2025 May 31];14(1):22–6. Available from: https://www.sciencedirect.com/science/article/pii/S2212426823001410
28. Oral health [Internet]. [cited 2025 May 31]. Available from: https://www.who.int/news-room/fact-sheets/detail/oral-health
29. Jacob L, Shin JI, Grabovac I, Haro JM, Koyanagi A, Tully MA, et al. Association between Diabetes and Dental Caries in Spanish Adults: A Cross-Sectional Study Including 23,089 Adults. Oral 2021, Vol 1, Pages 281-289 [Internet]. 2021 Sep 16 [cited 2025 Jun 2];1(3):281–9. Available from: https://www.mdpi.com/2673-6373/1/3/27/htm
30. Wu CZ, Yuan YH, Liu HH, Li SS, Zhang BW, Chen W, et al. Epidemiologic relationship between periodontitis and type 2 diabetes mellitus. BMC Oral Health [Internet]. 2020 Jul 11 [cited 2025 May 31];20(1):1–15. Available from: https://link.springer.com/articles/10.1186/s12903-020-01180-w
31. Yang Y, Sun X, Yang Y, Qie Y. Insight of the interrelationship and association mechanism between periodontitis and diabetes mellitus. Regen Ther [Internet]. 2024 Jun 1 [cited 2025 May 31];26:1159–67. Available from: https://www.sciencedirect.com/science/article/pii/S2352320424001937
32. Baeza M, Morales A, Cisterna C, Cavalla F, Jara G, Isamitt Y, et al. Effect of periodontal treatment in patients with periodontitis and diabetes: Systematic review and meta-analysis. J Appl Oral Sci [Internet]. 2020 [cited 2025 May 31];28. Available from: https://www.researchgate.net/publication/338527531_Effect_of_periodontal_treatment_in_patients_with_periodontitis_and_diabetes_Systematic_review_and_meta-analysis
33. Shettigar L, Sivaraman S, Rao R, Arun SA, Chopra A, Kamath SU, et al. Correlational analysis between salivary and blood glucose levels in individuals with and without diabetes mellitus: a cross-sectional study. Acta Odontol Scand [Internet]. 2024 Oct 12 [cited 2025 May 31];83:101–11. Available from: https://www.tandfonline.com/doi/pdf/10.1080/00016357.2023.2267678
34. Alqazlan FSA, Alazmi SO, Syed NK, Alshumaym AAA, Aloyouni AAA, Alfuryah KAG, et al. Glucose monitoring from gingival crevicular fluid blood among chronic periodontitis patients at Ar Rass, Saudi Arabia. Bioinformation [Internet]. 2024 Apr 30 [cited 2025 May 31];20(4):337. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11161876/
35. Gu M, Ge J, Pan Q, Hu N, Hua F. Salivary microbiome variations in type 2 diabetes mellitus patients with different stages of periodontitis. BMC Oral Health [Internet]. 2024 Dec 1 [cited 2025 May 31];24(1):1–11. Available from: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-024-05135-3
36. Luong A, Tawfik AN, Islamoglu H, Gobriel HS, Ali N, Ansari P, et al. Periodontitis and diabetes mellitus co-morbidity: A molecular dialogue. J Oral Biosci [Internet]. 2021 Dec 1 [cited 2025 May 31];63(4):360–9. Available from: https://www.sciencedirect.com/science/article/pii/S1349007921001420
37. Corridore D, Saccucci M, Zumbo G, Fontana E, Lamazza L, Stamegna C, et al. Impact of Stress on Periodontal Health: Literature Revision. Healthc 2023, Vol 11, Page 1516 [Internet]. 2023 May 22 [cited 2025 May 31];11(10):1516. Available from: https://www.mdpi.com/2227-9032/11/10/1516/htm
38. Rohini G, Kalaivani S, Kumar V, Rajasekar SA, Tuckaram J, Pandey V. Estimation and comparison of serum cortisol levels in periodontally diseased patients and periodontally healthy individuals: A clinical-biochemical study. J Pharm Bioallied Sci [Internet]. 2015 Aug 1 [cited 2025 May 31];7(6):S457–60. Available from: https://journals.lww.com/jpbs/fulltext/2015/07002/estimation_and_comparison_of_serum_cortisol_levels.29.aspx
39. Develioglu H, Korkmaz S, Dundar S, Schlagenhauf U. Investigation of the levels of different salivary stress markers in chronic periodontitis patients. J Oral Biol Craniofacial Res [Internet]. 2020 Oct 1 [cited 2025 May 31];10(4):514–8. Available from: https://www.sciencedirect.com/science/article/pii/S2212426820301147
40. Graziani F, Gennai S, Solini A, Petrini M. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes An update of the EFP-AAP review. J Clin Periodontol [Internet]. 2018 Feb 1 [cited 2025 May 31];45(2):167–87. Available from: /doi/pdf/10.1111/jcpe.12837