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ASSESSMENT OF SALIVARY LEVELS OF 8-OHDG IN PATIENTS WITH PERIODONTITIS AND/OR OBESITY

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Abstract

Background: Periodontitis is universally agreed to be an inflammatory disorder which arises as a consequence of periodontal pathogens interacting with the host's immune response. A significant and crucial element in the onset and advancement of periodontitis is oxidative stress. 8-OHdG is a molecule that's considered a significant biomarker of oxidative stress.

Aim of the study: Analyzing the salivary levels of 8-OHdG in patients with periodontitis/obesity in comparison to healthy controls with analysis of its correlation with various clinical periodontal parameters.

Materials and methods: 110 subjects (30 obese, 30 periodontitis, 30 obese periodontitis and 20 healthy subjects) took part in this study. Samples of saliva were acquired from all subjects before clinical examination. Full periodontal examination was conducted for each participant which entailed plaque index PLI, bleeding on probing BOP, probing pocket depth PPD and clinical attachment loss CAL. We assessed obesity utilizing body mass index BMI.

Results: It was showed that periodontitis patients and obese patients had significantly elevated concentrations of salivary 8-OHdG when compared with healthy subjects. Also these levels correlated positively with CAL in obese periodontitis patients.

Conclusions: This study revealed an association between 8-OHdG and periodontitis which implies that this biomarker serves a vital part in the periodontal disease process. Moreover, this study showed an association between this biomarker and obesity measures, which suggests that periodontitis and obesity are interconnected via oxidative stress.

Keywords: 8-OHdG, saliva, obesity, periodontitis, oxidative stress

Introduction

Periodontal disease is believed to be an illness of inflammatory origin which is caused by several factors that affect tissues that hold the teeth (alveolar bone and connective tissue). [1] Obesity is a diverse and multidimensional condition that has been connected to a number of medical conditions, such conditions include cancer, diabetes, and cardiovascular disease.[2] The epidemic of obesity has been called a pandemic on a global scale.[3] According to recent research, around 2.1 billion people worldwide are overweight or obese.[4] Obesity was also shown to have a high prevalence in Iraq.[5]

A relationship exists between periodontal disease and obesity according to several systematic studies and meta-analyses.[6, 7] Patients with obesity have a greater incidence of periodontal disease compared to normal weight subjects, and this link becomes stronger as BMI rises. [8] A recent study on Iraqi population demonstrated that periodontitis severity is associated with obesity, although other risk factors could be implicated [9]. The precise mechanism by which obesity affects periodontal disease is not yet fully understood. Obesity alters the immunological and inflammatory systems which influence the host's susceptibility. [10] Research implies that obesity may be linked to periodontitis through oxidative stress.[11] Hence, analysis of oxidative stress could be a beneficial technique to comprehend the pathologic pathways shared by two inflammatory disorders such as obesity and periodontal disease [12].

A significant product of oxidative damage to DNA is 8-hydroxy-2'–deoxyguanosine (8-OHdG) which's mediated by (ROS) [13]. It is a critical indicator of oxidative stress.[14] Several studies showed

greater concentrations of salivary 8-OHdG in individuals with periodontal disease when compared with healthy individuals, indicating an association between this biomarker and enhanced ROS generation during periodontal inflammation.[15-17]

The studies that inspected the relationship between this unique biomarker and periodontal disease are scarce. This paper evaluated this relationship and its association with obesity measures.

Patients and methods

Study design and patient population

The design of this study is observational case-control study, it was undertaken at the periodontics department of the Dental College of University of Baghdad. The University of Baghdad granted the ethical approval for this study (Ref. 454622 in January 19, 2022). Between March 2022 and June 2022, 110 subjects were recruited to take part in this study, which comprised of 30 patients with Periodontitis, 30 patients with obesity (BMI≥30), 30 patients with periodontitis and obesity, and 20 patients who were periodontally healthy with normal weight (BMI≤24.9). Informed consent was acquired from every participant before conducting this research which clarified the purpose of the study and the sampling procedure. The inclusion criteria for the enrollment into the study comprised of subjects aged between 30-50 years with no systemic diseases, not taking any medication in the last 3 months with 20 natural teeth at minimum, while subjects who were exempted from the study included smokers and alcohol drinkers, subjects with systemic disorders and subjects who have undergone periodontal therapy in the previous 3 months.

Saliva collection and data analysis

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Samples of whole unstimulated saliva were obtained from all participants prior to any oral examination. Whole saliva was collected by using the drooling method into a plastic cup which then was transferred into a test tube in a cooling box [18], later we centrifuged the samples at 3000 rpm for 10 minutes and were put in a storage unit at -80º C freezer until the analysis day. We thawed the samples to room temperature on the day of laboratory analysis.

The levels of 8-OHdG in saliva were determined utilizing an ELISA assay (Catalog number MBS720604) suitable for the quantitative detection of Human concentrations of 8-OHdG following the manufacturer's directions. The competitive enzyme immunoassay approach is used in this kit, which includes a polyclonal anti-8-OHdG antibody and an 8-OHdG-HRP conjugate. The sample and buffer are incubated with the 8-OHdG-HRP conjugate on a pre-coated plate for a period of one hour. HRP enzyme substrate is then incubated in the wells. A blue complex forms as a byproduct of the enzyme-substrate process. The process is finally halted by adding a stop solution, which turns the solution yellow. The spectrophotometric microplate reader at 450nm is used to determine the colour intensity. Since 8-OHdG from samples and 8-OHdG-HRP conjugate battle for the anti-8-OHDG antibody binding site, the intensity of the colour is inversely related to the levels of 8-OHdG.

Case definition and data collection

Prior to periodontal examination, the height and weight of every subject were determined by a scale and measuring tape. We classified participants into three weight groups with respect to their body mass index (BMI): Normal (BMI: 20–24.9), Overweight (BMI: 25–29.9) and Obese (BMI: ≥30). BMI

was calculated according to this equation: BMI = weight (Kg)/height(m2). [19]

A thorough periodontal examination by a calibrated examiner was performed using Michigan O probe, which consisted of plaque index (PI), bleeding on probing (BOP), Probing pocket depth (PPD) and Clinical attachment loss (CAL). All teeth surfaces were examined for all parameters except for PI where only four surfaces were examined. Subjects were classified as periodontitis when CAL was found at ≥2 non adjacent teeth Or buccal/oral CAL≥3mm with pocket>3mm at ≥2 teeth [20]. While healthy subjects were classified when BOP<10%, PPD≤3mm, intact periodontium (no probing attachment loss) [21].

Statistical analysis

SPSS (version 25) was utilised for both descriptive and inferential statistical analysis. Checking the normality of data was performed Utilizing Shapiro-Wilk test which revealed that all studied variables had a normal distribution among groups at $p>0.05$. To statistically evaluate the differences in gender distribution, we used chi-squared test as it is considered a categorical data. For the rest of the parameters, we found it to be normally distributed between healthy and diseased patients and since this study had 4 groups, two-way ANOVA test was used for the parameters' evaluations. Correlations of 8-OHdG were analysed using Pearson's correlation test with the various clinical periodontal parameters. A significance level of $\alpha=0.05$ was used for every test of this study.

Results

110 subjects took part in this study, they were divided into healthy control group (n=20), obese group (n=30), periodontitis group (n=30), and obese

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periodontitis group (n=30). The age ranged between 30-50 years in all groups, the control group had a mean age of 37.55±7.95 years. The obese group had a mean age of 36.30±5.44 years and the mean age of periodontitis group was 37.13±6.46 years while in obese periodontitis group it was 40.46±6.64 years. Regarding gender, 51.82% of the total participants were females, while males constituted 48.18%. For age (p=0.083) and gender (p=0.692) there was no significant difference among all groups .

The mean level of 8-OHdG in saliva was 0.9 ng/ml in healthy control group, 1.29 ng/ml in obese group, 1.9 ng/ml in periodontitis group and 1.47 ng/ml in obese periodontitis group. The levels of 8-OHdG and all parameters in this study across all groups have been summarized in the table below Table 1.

Table I Mean values of all parameters and comparisons between all study groups

Parameters	Mean values				*P* values			
	Healthy n=20	Obese n=30	Periodontitis n=30	Obese Periodontitis n=30	Healthy vs Obese	Healthy vs Periodontitis	Obese vs obese periodontitis	Periodontitis vs obese periodontitis
PI (%)	20.25±7.50	21.7±10.39	40.4±24.39	44.6±21.22	0.78^{NS}	**<0.001****	**<0.001****	0.37^{NS}
BOP (%)	2.5±2.35	4.53±2.27	36.93±26.29	34.1±20.4	0.68^{NS}	**<0.001****	**<0.001****	0.53^{NS}
PPD (mm)	-	-	4.62±0.55	4.61±0.49	-	-	-	0.93^{NS}
CAL (mm)	-	-	3.46±0.98	3.69±1.02	-	-	-	0.40^{NS}
8-OHdG (ng/ml)	0.9±0.16	1.29±0.52	1.9±0.12	1.47±0.24	**<0.001****	**<0.001****	**0.031****	**<0.001****

*Significant
**Highly significant
^{NS}Non-significant

Regarding plaque index (PLI) and bleeding on probing (BOP), a significant difference was found between healthy control group and periodontitis group, also a significant difference between obese group and obese periodontitis group; however, we did not find any significant difference between periodontitis group and obese periodontitis group in terms of PLI and BOP. On the other hand, when we compared

periodontitis and obese periodontitis groups in terms of (PPD) and (CAL), there was no significant difference noticed between these groups.

Regarding the levels of salivary 8-OHdG, a significant difference was noted between healthy control group and periodontitis group as between healthy control group and obese group, also a significant difference was found between obese group and obese periodontitis group.

On correlating the salivary levels of 8-OHdG with various clinical parameters as shown in Table II, we found a significant moderate positive correlation between this biomarker and CAL in obese periodontitis group as illustrated in [Figure 1].

Table II Correlations of the clinical parameters with 8-OHdG salivary levels in all study groups

Groups		PLI	BOP	PPD	CAL
Healthy	*r* value	0.32	-0.11	-	-
	p value	0.15^{NS}	0.64^{NS}	-	-
Obese	*r* value	0.08	0.002	-	-
	p value	0.66^{NS}	0.99^{NS}	-	-
Periodontitis	*r* value	0.08	0.01	0.24	0. 2
	p value	0.65^{NS}	0.94^{NS}	0.24^{NS}	$0.2\ 6^{NS}$
Obese periodontitis	*r* value	0.25	0.14	0.22	0.5
	p value	0.17^{NS}	0.45^{NS}	0.31^{NS}	**0.00 4****

*Significant
**Highly significant
^{NS}Non-significant

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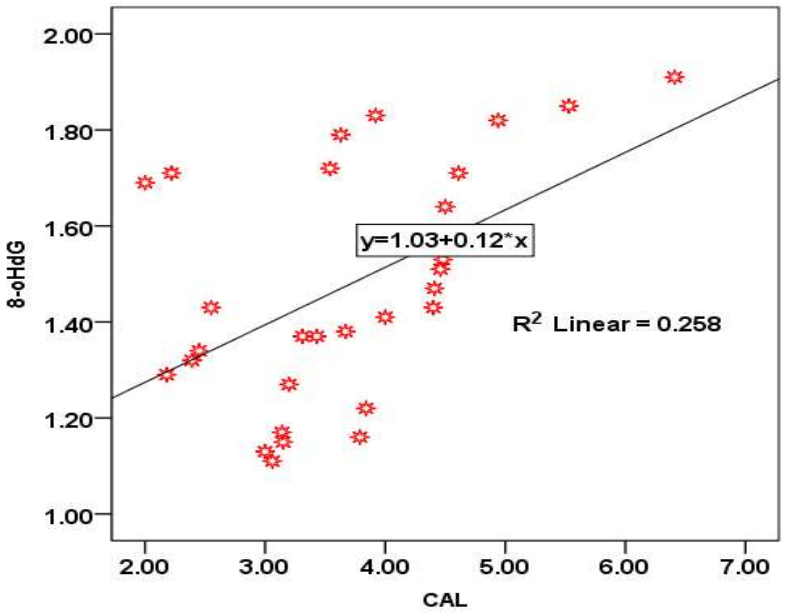

Fig. 1 Correlation of salivary concentrations of 8-OHdG with CAL in obese periodontitis group

Discussion

This paper sought to assess the levels of 8-OHdG in saliva and its relation to periodontal disease. We also investigated its association with obesity. 8-OHdG is the most prevalent outcome of oxidative DNA repair and researchers have relied on this stable oxidatively modified DNA product as a benchmark of the extent of oxidation damage of DNA.[13] Periodontal disease is an illness of inflammatory origin which can be considered as primary etiological factor for tooth loss, leading to destruction to all structures supporting the teeth which include mainly periodontal ligament, root cement, and alveolar bone. Many studies have shown that oxidative stress, as well as an individual's total antioxidant capability, play a substantial part in the etiology of periodontal disorders. Lower levels of antioxidants in gingival crevicular fluid (GCF) were linked to exacerbated gingival and structural damage induced by neutrophils. [16] Similarly, a second research demonstrates an association between periodontal disease and hyperreactive neutrophils that have enhanced generation of (ROS).[22] According to several studies, higher concentrations of 8-OHdG in saliva were noticed in individuals with periodontal disease compared to those in healthy individuals, indicating that the aforementioned biomarker is associated with enhanced (ROS) generation during periodontal inflammation.[15-17] Similarly,

when periodontitis patients get effective anti-inflammatory medication, its levels decrease.[17] Recent research revealed that the presence of periodontal bacteria is strongly associated with the salivary 8-OHdG concentrations, and they were much greater than other oxidative stress indicators.[23]

In this study, a significant difference was found when we compared healthy control group with periodontitis group, also a significant difference was found between obese group and obese periodontitis group. Salivary concentrations of 8-OHdG in saliva are always increasing in the periodontitis group whether normal weight or obese (more than double in periodontitis group in comparison to control group). This result agrees with many previous studies which found that the levels of 8-OHdG in saliva to be high and sometimes very high in periodontitis group with a significant difference.[23-25] Periodontitis is an irreversible illness caused by microbial plaque.[26] Large amounts of neutrophils, enzymes, and (ROS) are released in reaction to microbial plaque, and this is thought to be the primary cause of tissue damage.[27] (ROS) levels have been found to rise during periodontitis.[28] Damage to DNA could occur as a consequence of (ROS) accumulation; a hallmark of damaged DNA damage is 8-OHdG, which is secreted in bodily fluids. A variety of chronic inflammatory disorders, such as periodontitis, have been associated with the levels of 8-OHdG. [29]

In relation to obesity, clinical, animal, and epidemiological investigations established the relevance of oxidative stress in the development of obesity and its associated risk factors.[30] Oxidative stress may promote obesity through enhancing white adipose tissue formation and modifying intake of food; it has been shown that oxidative stress may enhance preadipocyte expansion and adipocyte differentiation.[31] It has been reported that (ROS) can be engaged in regulating body weight by affecting hypothalamic neurons, which govern satiety and hunger behavior. [32]

A significant difference was revealed in this study in the levels of salivary 8-OHdG between healthy and obese groups (both periodontally healthy) and these levels increased in the obese group. This result is consistent with a study that found significantly higher concentrations of salivary 8-OHdG in obese patients compared to normal weight subjects [33]. This rise in 8-OHdG concentrations in obese group can be explained on the basis of oxidative stress

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which is indicated by 8-OHdG levels. DNA, proteins and lipids are all prone to oxidative damage when exposed to high levels of (ROS).[34] Several biochemical pathways, including superoxide formation by NADPH oxidases (NOX) and oxidative phosphorylation are triggered by obesity to induce a state of systemic oxidative stress [30]. Consistent with our findings, a previous research discovered that the levels of 8-OHdG rose with the severity of obesity and a positive correlation between 8-OHdG and BMI was found.[35]. Surprisingly, another investigation found lower concentrations of 8-OHdG in plasma of obese patients compared to normal weight people. This reduction in obese people may be related to the base excision repair (BER) pathway repairing certain 8-OHdG damages. [36]

This study revealed a significant moderate positive correlation between 8-OHdG and CAL in obese periodontitis group. Currently, the available literature is very limited. However; a previous study did not find any correlation between 8-OHdG and CAL in obese periodontitis patients and only revealed a significant positive correlation between GCF 8-OHdG and GI (gingival index).[37] 8-OHdG has been shown to correlate positively with clinical periodontal parameter (CAL), This may be associated with the duration of the disease, and indirectly, the severity of the illness since prolonged cytokines stimulation such as TNF-α causes both an increase in extracellular (ROS) generation through PMN activation and an increase in mitochondrial (ROS production). This idea is consistent with periodontitis features. [38]

Conclusion

This study illustrated an association between the salivary levels of 8-OHdG and periodontitis, this study also suggested an association between salivary levels of 8-OHdG and obesity. 8-OHdG is a significant indicator and biomarker of oxidative stress that reflects levels of DNA damage. Obesity and periodontitis may be linked through their shared association with oxidative stress, which reflects an importance in maintaining a healthy lifestyle and reducing exposure to risk factors for these conditions.

References

1.Papapanou PN, Sanz M, Buduneli N, Dietrich T, Feres M, Fine DH, et al. Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol. 2018;45 Suppl 20:S162-s70

2.Hu F. Obesity Epidemiology: Oxford University Press, USA; 2008. https://doi.org/10.1093/acprof:oso/9780195312911.001.0001.

3.Abas D, Eqbal G. Prevalence of obesity among adolescents at secondary schools in Kirkuk city. Iraqi National Journal of Nursing Specialties. 2018;26:96-101. https://doi.org/10.58897/injns.v26i2.175.

4.Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-81 https://doi.org/10.1016/S0140-6736(14)60460-8.

5.Jasim HM, Abdul Hussein HM, Al-Kaseer EA. Obesity among females in Al-Sader city Baghdad, Iraq, 2017. Journal of the Faculty of Medicine Baghdad. 2018;60(2):105-7 https://doi.org/10.32007/19jfacmedbaghdad36.v60i2.15.

6.Martinez-Herrera M, Silvestre-Rangil J, Silvestre FJ. Association between obesity and periodontal disease. A systematic review of epidemiological studies and controlled clinical trials. Med Oral Patol Oral Cir Bucal. 2017;22(6):e708-e15. https://doi.org/10.4317/medoral.21786.

7.Nascimento GG, Leite FR, Do LG, Peres KG, Correa MB, Demarco FF, et al. Is weight gain associated with the incidence of periodontitis? A systematic review and meta-analysis. J Clin Periodontol. 2015;42(6):495-505. https://doi.org/10.1111/jcpe.12417.

8.Pataro AL, Costa FO, Cortelli SC, Cortelli JR, Abreu MH, Costa JE. Association between severity of body mass index and periodontal condition in women. Clin Oral Investig. 2012;16(3):727-34 https://doi.org/10.1007/s00784-011-0554-7.

9.Gul S, Imran N, Al-Sharqi A, Abdulkareem A. Association of overweight/obesity with the severity of periodontitis using BPE code in an iraqi population. Clinical Epidemiology and Global Health. 2020;9 https://doi.org/10.1016/j.cegh.2020.06.005.

10.Ismail H, Mahmood M. Effect of melatonin supplementation on the gingival health and lipid profiles in obese periodontitis patients. Journal of Baghdad College of Dentistry. 2022;34:51-9 https://doi.org/10.26477/jbcd.v34i1.3092.

11.Jepsen S, Suvan J, Deschner J. The association of periodontal diseases with metabolic syndrome and obesity. Periodontol 2000. 2020;83(1):125-53. https://doi.org/10.1111/prd.12326.

Document Type : Original Article, Doi: https://doi.org/10.33762/bsurg.2023.139530.1049

12.Dursun E, Akalin FA, Genc T, Cinar N, Erel O, Yildiz BO. Oxidative Stress and Periodontal Disease in Obesity. Medicine (Baltimore). 2016;95(12):e3136. https://doi.org/10.1097/MD.0000000000003136.

13.Chapple IL, Matthews JB. The role of reactive oxygen and antioxidant species in periodontal tissue destruction. Periodontol 2000. 2007;43:160-232. https://doi.org/10.1111/j.1600-0757.2006.00178.x.

14.Paredes-Sánchez E, Montiel-Company JM, Iranzo-Cortés JE, Almerich-Torres T, Bellot-Arcís C, Almerich-Silla JM. Meta-Analysis of the Use of 8-OHdG in Saliva as a Marker of Periodontal Disease. Dis Markers. 2018;2018:7916578. https://doi.org/10.1155/2018/7916578.

15.Buczko P, Zalewska A, Szarmach I. Saliva and oxidative stress in oral cavity and in some systemic disorders. J Physiol Pharmacol. 2015;66(1):3-9..

16.Trivedi S, Lal N. Antioxidant enzymes in periodontitis. J Oral Biol Craniofac Res. 2017;7(1):54-7 https://doi.org/10.1016/j.jobcr.2016.08.001.

17.Henry LG, McKenzie RM, Robles A, Fletcher HM. Oxidative stress resistance in Porphyromonas gingivalis. Future Microbiol. 2012;7(4):497-512. https://doi.org/10.2217/fmb.12.17.

18.Tenovuo J, Lagerlof F. Textbook of clinical cardiology. 2nd ed. A T, O. F, editors. Munksgaard Copenhagen: Munksgaard Copenhagen; 1994. 17-43 p..

19.Nuttall FQ. Body Mass Index: Obesity, BMI, and Health: A Critical Review. Nutr Today. 2015;50(3):117-28. https://doi.org/10.1097/NT.0000000000000092.

20.Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. J Clin Periodontol. 2018;45 Suppl 20:S149-s61 https://doi.org/10.1111/jcpe.12945.

21.Chapple ILC, Mealey BL, Van Dyke TE, Bartold PM, Dommisch H, Eickholz P, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Periodontol. 2018;89 Suppl 1:S74-s84.

22.Podzimek S, Vondrackova L, Duskova J, Janatova T, Broukal Z. Salivary Markers for Periodontal and General Diseases. Dis Markers. 2016;2016:9179632. https://doi.org/10.1155/2016/9179632.

23.Almerich-Silla JM, Montiel-Company JM, Pastor S, Serrano F, Puig-Silla M, Dasí F. Oxidative Stress Parameters in Saliva and Its Association with Periodontal Disease and Types of Bacteria. Dis Markers. 2015;2015:653537. https://doi.org/10.1155/2015/653537.

24.Sezer U, Çiçek Y, Canakçi CF. Increased salivary levels of 8-hydroxydeoxyguanosine may be a marker for disease activity for periodontitis. Dis Markers. 2012;32(3):165-72. https://doi.org/10.1155/2012/215430.

25.Zamora-Perez AL, Ortiz-García YM, Lazalde-Ramos BP, Guerrero-Velázquez C, Gómez-Meda BC, Ramírez-Aguilar M, et al. Increased micronuclei and nuclear abnormalities in buccal mucosa and

oxidative damage in saliva from patients with chronic and aggressive periodontal diseases. J Periodontal Res. 2015;50(1):28-36. https://doi.org/10.1111/jre.12175.

26.Miricescu D, Totan A, Calenic B, Mocanu B, Didilescu A, Mohora M, et al. Salivary biomarkers: relationship between oxidative stress and alveolar bone loss in chronic periodontitis. Acta Odontol Scand. 2014;72(1):42-7. https://doi.org/10.3109/00016357.2013.795659.

27.Canakçi CF, Cicek Y, Canakçi V. Reactive oxygen species and human inflammatory periodontal diseases. Biochemistry (Mosc). 2005;70(6):619-28. https://doi.org/10.1007/s10541-005-0161-9.

28.Su H, Gornitsky M, Velly AM, Yu H, Benarroch M, Schipper HM. Salivary DNA, lipid, and protein oxidation in nonsmokers with periodontal disease. Free Radic Biol Med. 2009;46(7):914-21 https://doi.org/10.1016/j.freeradbiomed.2009.01.008.

29.Takane M, Sugano N, Ezawa T, Uchiyama T, Ito K. A marker of oxidative stress in saliva: association with periodontally-involved teeth of a hopeless prognosis. J Oral Sci. 2005;47(1):53-7 https://doi.org/10.2334/josnusd.47.53.

30.Savini I, Catani MV, Evangelista D, Gasperi V, Avigliano L. Obesity-associated oxidative stress: strategies finalized to improve redox state. Int J Mol Sci. 2013;14(5):10497-538 https://doi.org/10.3390/ijms140510497.

31.Higuchi M, Dusting GJ, Peshavariya H, Jiang F, Hsiao ST, Chan EC, et al. Differentiation of human adipose-derived stem cells into fat involves reactive oxygen species and Forkhead box O1 mediated upregulation of antioxidant enzymes. Stem Cells Dev. 2013;22(6):878-88 https://doi.org/10.1089/scd.2012.0306.

32.Horvath TL, Andrews ZB, Diano S. Fuel utilization by hypothalamic neurons: roles for ROS. Trends Endocrinol Metab. 2009;20(2):78-87. https://doi.org/10.1016/j.tem.2008.10.003.

33.Zalewska A, Kossakowska A, Taranta-Janusz K, Zięba S, Fejfer K, Salamonowicz M, et al. Dysfunction of Salivary Glands, Disturbances in Salivary Antioxidants and Increased Oxidative Damage in Saliva of Overweight and Obese Adolescents. J Clin Med. 2020;9(2) https://doi.org/10.3390/jcm9020548.

34.Kroese LJ, Scheffer PG. 8-hydroxy-2'-deoxyguanosine and cardiovascular disease: a systematic review. Curr Atheroscler Rep. 2014;16(11):452. https://doi.org/10.1007/s11883-014-0452-y.

35.Elwakkad A, Hassan NE, Sibaii H, Zayat Se, Sherif L, Hameed E-R-A, et al. Amany Elwakkad, Nayera Elmorsi Hassan, Hiba Sibaii, Salwa el Zayat, Lobna Sherif, Enas-R-Abdel Hameed and Azza-Abdel Shaheed, 2011. Relationship Between Obesity and 8-hydroxy-2-deoxy Guanosine as an Oxidative Marker in Obese Adolescents of Giza. Journal of Medical Sciences, 11: 231-235. 2011 https://doi.org/10.3923/jms.2011.231.235.

36.Storr SJ, Woolston CM, Martin SG. Base excision repair, the redox environment and therapeutic implications. Curr Mol Pharmacol. 2012;5(1):88-101. https://doi.org/10.2174/1874467211205010088.

37.Öngöz Dede F, Bozkurt Doğan Ş, Ballı U, Avcı B, Durmuşlar MC. The effect of initial periodontal treatment on plasma, gingival crevicular fluid and salivary levels of 8-hydroxy-deoxyguanosine in obesity. Arch Oral Biol. 2016;62:80-5. https://doi.org/10.1016/j.archoralbio.2015.11.014.

38.Canakçi CF, Canakçi V, Tatar A, Eltas A, Sezer U, Ciçek Y, et al. Increased salivary level of 8-hydroxydeoxyguanosine is a marker of premature oxidative mitochondrial DNA damage in gingival tissue of patients with periodontitis. Arch Immunol Ther Exp (Warsz). 2009;57(3):205-11 https://doi.org/10.1007/s00005-009-0026-9.

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Data collection and analysis: 1
Responsibility for statistical analysis: 1,2
Writing the article: 1,2
Critical review: 1,2
Final approval of the article: 1,2
Each author believes that the manuscript represents honest work and certifies that the article is original, is not under consideration by any other journal, and has not been previously published.
Availability of Data and Material:
The corresponding author is prompt to supply datasets generated during and/or analyzed during the current study on wise request.

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