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CORRELATION OF GLUCOSE, LIPID METABOLISM INDICES AND INFLAMMATORY BLOOD CELL MARKERS WITH PERIODONTAL STATUS : A PRELIMINARY CROSS-SECTIONAL STUDY

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Abstract

Background:

There is conflicting evidence about the relationship between diabetes, dyslipidemia, and changes in periodontal health. Periodontitis has been linked to an increased risk of diabetes and cardiovascular illnesses, according to recent studies. The aim of this study was to determine the relationship between periodontal status, lipid profiles and glycemic status in a systemically healthy population.

Methods: 339 Systemically healthy patients aged between 18-60 years were recruited for this study. A periodontal examination consisting of plaque and bleeding indices and periodontal charting was done. Blood examination consisting of glycemic and lipid parameters were also conducted for all participants. Based on the latest AAP classification of periodontal diseases and conditions, the participants were grouped as periodontally healthy, gingivitis and periodontitis groups and blood parameters were compared across these 3 groups. The obtained data was entered into Microsoft excel sheet and then analyzed using SPSSV 27 software.

Results: The glucose and lipid metabolism indexes and blood inflammatory biomarkers did not show to have any correlation with periodontal disease status across both genders of the population. ($P>0.05$) although their mean values were higher in the disease groups compared to healthy and the mean HDL levels were higher in the healthy group.

Conclusion: Although higher mean values of glucose and lipid parameters were found in periodontally diseased groups, their precise correlation needs to be further explored.

KEYWORDS

Blood cell biomarkers, glucose metabolism, lipid profile, periodontitis

INTRODUCTION

Microorganisms that build up on the surface of teeth in dental plaque, can induce gingivitis, an inflammatory disease that is limited to the gingiva. Untreated gingivitis can progress to periodontitis, which is characterized by the breakdown of the tissues that support teeth and ultimately results in the loss and mobility of teeth[1]. According to epidemiological survey reports, the percentage of individuals with severe periodontitis was 8.5%, and the prevalence of overall periodontitis, which includes mild, moderate, and severe forms, was 47.7%[2,3]. Although bacterial biofilms in high quantities are the cause

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of periodontitis, the host immune system can influence the diseasecourse[4]. Thus, there may be a risk of periodontitis if the systemic disease affects the host response[5].
Hyperglycemia, a metabolic disorder caused by abnormalities in insulin action and/or secretion, is a defining feature of diabetes[6]. The sixth consequence of diabetes is thought to be periodontal disease[7]. Research indicates that diabetes may either cause or exacerbate periodontal disease[8]. Dyslipidemia has been identified as a major risk factor for cardiovascular illnesses. Recent studies have indicated that about 43% of adults in Saudi Arabia have dyslipidemia.[9]And recent research also suggest that dyslipidemia and changes in periodontal health are related[10].

Periodontitis is characterized by localized inflammation, but it has also been shown to have a systemic impact. Changes in the plasma density of hormones and cytokines brought on by severe systemic or chronic infections, including periodontitis, might modify lipid metabolism.[11] Bacteria from periodontal disease enter the bloodstream and modify blood coagulation, endothelium, coronary wall, and platelet function. These changes can lead to atherosclerosis of the coronary artery.[12] The infection brought on by chronic periodontitis raises plasma lipid levels, which in turn is accompanied by a rise in pre-inflammatory cytokines.[13]Severe periodontitis has also been linked to a more marked increase in plasma triglycerides (TG), a slight increase in low density lipoprotein (LDL) cholesterol, and a modest drop in high density lipoprotein (HDL) cholesterol.[14-17]The biological signaling molecules from the circulation that originate in local inflammation caused by periodontal disease have a wide range of physiological consequences that promote impaired lipid clearance, increased lipolysis, and accelerated lipogenesis. Hyperlipidemia, or a build-up of LDL, TG, and free fatty acids (FFA) in the blood, is the ultimate outcome. However, a number of studies also clearly show that hyperlipidemia may play a part in periodontitis. White blood cell hyperactivity is known to be caused by hyperlipidemia[17,18]. Periodontitis has been demonstrated to be frequently connected with hyperactivity of white blood cells, such as increased generation of oxygen radicals.[19-21].
Research is currently in progress to determine how periodontitis relates to at least 57 systemic diseases and disabilities.[22] Low-grade systemic inflammation brought on by periodontitis may be one of the many pathways linking the two conditions to systemic comorbidities.[23]Molecular analysis comparing the peripheral blood of patients with severe periodontitis to that of periodontally healthy individuals, revealed elevated levels of pro-inflammatory mediators[24-26](such as C-reactive protein, IL-1, IL-6, and calprotectin) and specific blood constituents[27,28](such as platelets, neutrophils, and neutrophil-to-lymphocyte ratio). Periodontal disease has also been known to disrupt patients' glycemic and lipid metabolism, which raises their risk of developing diabetes mellitus, obesity, and cardiometabolic disorders.[29,30]Previous research, however, has mostly concentrated on index differences between those with periodontitis and those who are periodontally healthy. Additionally, the majority of earlier studies looked into how people with systemic disease status changed in their index. It is unknown if patients with periodontitis, gingivitis, and periodontally healthy individuals who are systemically healthy differ in their glucose and lipid metabolism indices. Consequently, our goal was to find out how blood inflammatory biomarkers and established indices of glucose and lipid metabolism related to the different periodontal conditions viz periodontitis , gingivitis and periodontally health in systemically healthy males and females. It is interesting to assess whether both blood sugar and obesity are related

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to periodontal diseases.

MATERIALS AND METHODS

2.1 Study population

The goal of the current study was to investigate, in a representative sample of the Saudi Arabian population, the relationships between blood inflammatory biomarkers, periodontal status, and glucose and lipid metabolism indicators. From August 2023 to April 2024, a total of 339 systemically healthy individuals, ages 18 to 71, from the dental clinics at ISNC, Jeddah, KSA, were assessed. The research review board of the institution's ethical committee accepted the study protocol (IRRB-ER/02-10082023). Written informed consent was obtained from each participant before gathering data. Subjects with any kind of systemic illness, who were pregnant, had received antibiotics within the last three months, had undergone periodontal therapy within the past year, smoked, or used any tobacco products were not allowed to participate in the study.

2.2 Clinical and radiological measurement

For the eligible individuals, full-mouth periodontal charting which included Probing Depth(PD), Attachment Loss(AL), Bleeding Index, and Plaque index (PI) were performed. PD and AL were recorded at six places on each tooth: mesiobuccal/mesiopalatal, midbuccal/midlabial, distobuccal/disttolabial, mesiolingual/mesiopalatal, midlingual/midpalatal, and distolingual/distopalatal.In order to determine thegrade of periodontitis, the bone loss at the worst site relative to age of patient was ascertained using full-mouth radiographs of the entire dentition.

2.3 Blood examination

All participants had their fasting blood samples drawn in the morning via venipuncture in order to have blood cells analyzed by hematological analyzers and serum protein analyzed by biochemical analyzers. Neutrophil percentage (NEUT%) and platelet count (PLT) were the two measurements used to analyze blood cells. Total cholesterol (CHO), triglycerides (TG), high-density lipoprotein cholesterol (LDL), low-density lipoprotein cholesterol (LDL), random and fasting glucose (GLU), and glycated hemoglobin were among the serum protein markers.(HbA1C)

Statistical Analysis

The data was obtained and entered in Microsoft Excel Version 13. The data was subjected to Statistical Analysis using IBM SPSS Version 27. For continuous data Mean and Standard Deviation was obtained. For Comparison of the Parameters between Periodontal conditions, One Way ANOVA was applied. Binomial Logistic Regression was applied keeping outcome variables as Periodontal Diagnosis and adjusting Gender as factor. All the statistical tests were applied keeping confidence interval at 95% and ($p<0.05$) was considered to be statistically significant.

RESULTS:

Table 1:

The descriptive parameters assessed for all parameters showed that the Bleeding Index, Total

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Cholesterol and LDL was high for patients with Gingivitis. The Mean Age, Mean Plaque Index, Neutrophil %, Total Cholesterol, Triglycerides, fasting glucose (FBS), Random Blood Glucose (RBS) and HbA1c was highest for Patients with Periodontitis. The Mean HDL was high for Healthy Patients.

TABLE 1: Descriptive Table for Parameters

	Periodontal Diagnosis	N	Mean	SD	Minimum	Maximum
Age	Healthy	42	31.786	11.306	19	66
	Gingivitis	142	36.676	12.305	19	79
	Periodontitis	155	39.006	12.026	19	79
Plaque Index	Healthy	42	0.404	0.271	0.0600	0.900
	Gingivitis	142	0.414	0.284	0.0400	0.900
	Periodontitis	155	0.438	0.225	0.0400	0.830
Bleeding Index	Healthy	42	0.366	1.527	0.0000	10.000
	Gingivitis	142	0.754	2.273	0.0100	10.000
	Periodontitis	155	0.208	0.160	0.0100	0.640
Neutrophil %	Healthy	42	51.524	11.737	16	83
	Gingivitis	142	52.556	11.370	16	83
	Periodontitis	155	53.032	12.470	16	83
Total Cholesterol	Healthy	42	157.381	31.393	100	268
	Gingivitis	142	164.303	40.223	98	283
	Periodontitis	155	166.497	38.093	98	274
Triglycerides	Healthy	42	113.976	29.433	39	177
	Gingivitis	142	126.521	64.424	39	496
	Periodontitis	155	131.213	63.906	40	496
HDL	Healthy	42	54.881	13.781	30	92
	Gingivitis	142	50.225	12.644	26	92
	Periodontitis	155	49.671	13.221	26	92
LDL	Healthy	42	92.476	25.810		
	Gingivitis	142	96.049	29.560	45	160
	Periodontitis	155	95.626	30.530	45	166
Fasting glucose(FBS)	Healthy	42	86.190	11.746	65	133
	Gingivitis	142	90.458	26.809	65	290
	Periodontitis	155	96.613	42.183	65	290
Random Blood Glucose(RBS)	Healthy	42	111.690	17.824	80	155
	Gingivitis	142	119.099	38.481	59	372
	Periodontitis	155	122.058	44.384	59	372
HbA1c	Healthy	42	4.843	1.510	3.3000	12.900

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	Gingivitis	142	5.020	1.544	3.2000	13.700
	Periodontitis	155	5.332	1.904	3.2000	13.700

Table 2:
When comparison of the parameters between Periodontal Diagnosis was performed by ANOVA, it was observed that the difference in Mean was statistically significant only for Bleeding Index and Periodontal conditions.(P<0.05)However between other parameters, the difference in Mean was not statistically significant (P >0.05)

TABLE 2: Comparison of the Parameters between Periodontal Diagnosis One-Way ANOVA

	F	df1	df2	p
Plaque Index	0.475	2	336	0.622
Bleeding Index	4.558	2	336	0.011
Platelet Count	0.116	2	336	0.890
Neutrophil %	0.271	2	336	0.763
Total Cholesterol	0.939	2	336	0.392
Triglycerides	1.331	2	336	0.266
HDL	2.707	2	336	0.068
LDL	0.244	2	336	0.784
Fasting glucose(FBS)	2.146	2	336	0.119
Random Blood Glucose(RBS)	1.151	2	336	0.318
HbA1c	1.949	2	336	0.144

Table 3:
Post-Hoc analysis of the Pairwise Comparison of the Parameters between Periodontal Diagnosis depicted that the difference in Mean Bleeding Index Score was statistically significant for Gingivitis only (p<0.05).

TABLE 3: Pairwise Comparison of the Parameters between Periodontal Diagnosis Tukey Post-Hoc Test – Bleeding Index

		Healthy	Gingivitis	Periodontitis
Healthy	Mean difference		-0.388	0.158
	p-value		0.339	0.832
Gingivitis	Mean difference			0.546
	p-value			0.008
Periodontitis	Mean difference			—
	p-value			—

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Note. * p < .05, ** p < .01, *** p < .001

Table 4:
The Binary Logistic Regression adjusted for Gender with Outcome Variable as periodontal Diagnosis for Parameters Gingivitis vs Periodontally healthy depicted that there was no statistically significant difference (p>0.05)

TABLE 4: Model Coefficients - Periodontal Diagnosis

						95% Confidence Interval	
Predictor	**Estimate**	**SE**	**Z**	**p**	**Odds ratio**	**Lower**	**Upper**
Intercept	0.18321	2.02758	0.0904	0.928	1.201	0.0226	63.891
Gender:							
Female – Male	-0.00715	0.36683	-0.0195	0.984	0.993	0.4838	2.038
Plaque index	0.07848	0.66475	0.1181	0.906	1.082	0.2939	3.980
Bleeding index	0.14595	0.12197	1.1966	0.231	1.157	0.9111	1.470
Platelet Count	-5.77e−7	1.46e-6	-0.3962	0.692	1.000	1.0000	1.000
Neutrophil %	0.00756	0.01652	0.4576	0.647	1.008	0.9755	1.041
Total Cholesterol	0.00384	0.00649	0.5924	0.554	1.004	0.9912	1.017
Triglycerides	0.00520	0.00569	0.9126	0.361	1.005	0.9941	1.016
HDL	-0.03274	0.01559	-2.0999	0.036	0.968	0.9387	0.998
LDL	7.46e-4	0.00795	0.0938	0.925	1.001	0.9853	1.016
Fasting glucose(FBS)	0.00626	0.01037	0.6035	0.546	1.006	0.9860	1.027
Random Blood Glucose(RBS)	0.00782	0.00868	0.9010	0.368	1.008	0.9908	1.025
HbA1c	-0.08624	0.17632	-0.4891	0.625	0.917	0.6493	1.296

Note. Estimates represent the log odds of "Periodontal Diagnosis = Gingivitis" vs. "Periodontal Diagnosis = Healthy"

Table 5:
The Binary Logistic Regression adjusted for Gender with Outcome Variable as periodontal Diagnosis between Healthy and Individuals with Periodontitis for Parameters depicted that there was no statistically significant difference (p>0.05)

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TABLE 5: Binomial Logistic Regression

Model Coefficients - Periodontal Diagnosis						95% Confidence Interval	
Predictor	**Estimate**	**SE**	**Z**	**p**	**Odds ratio**	**Lower**	**Upper**
Intercept	-1.15682	2.25904	-0.512	0.609	0.314	0.00376	26.333
Gender:							
Female – Male	-0.35389	0.37438	-0.945	0.345	0.702	0.33700	1.462
Plaque index	0.88432	0.78179	1.131	0.258	2.421	0.52311	11.208
Bleeding index	-0.42959	0.26602	-1.615	0.106	0.651	0.38636	1.096
Platelet Count	-7.36e−7	1.55e-6	-0.474	0.636	1.000	1.00000	1.000
Neutrophil %	0.00585	0.01473	0.397	0.691	1.006	0.97724	1.035
Total Cholesterol	-0.00329	0.00787	-0.417	0.676	0.997	0.98146	1.012
Triglycerides	0.00894	0.00661	1.352	0.177	1.009	0.99599	1.022
HDL	-0.03146	0.01509	-2.086	0.037	0.969	0.94079	0.998
LDL	0.00250	0.00806	0.311	0.756	1.003	0.98680	1.018
Fasting glucose(FBS)	0.01147	0.01171	0.979	0.327	1.012	0.98858	1.035
Random Blood Glucose(RBS)	0.01313	0.01034	1.270	0.204	1.013	0.99289	1.034
HbA1c	0.10285	0.20721	0.496	0.620	1.108	0.73841	1.664

Note. Estimates represent the log odds of "Periodontal Diagnosis = Periodontitis" vs. "Periodontal Diagnosis = Healthy"

Table 6:

The Binary Logistic Regression adjusted for Gender with Outcome Variable as periodontal Diagnosis between Gingivitis with Periodontitis for Parameters depicted None of the predictors in this model show a statistically significant association with the odds of having periodontitis versus gingivitis, as all p-values are above the conventional significance level of 0.05. This suggests that the predictors included in this model may not be strong determinants of periodontal diagnosis within this particular dataset.**TABLE 6: Model Coefficients - Periodontal Diagnosis**

						95% Confidence Interval

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Predictor	Estimate	SE	Z	p	Odds ratio	Lower	Upper
Intercept	0.16252	1.15954	0.1402	0.889	1.176	0.121	11.42
Gender:							
Female – Male	-0.27734	0.24227	-1.1448	0.252	0.758	0.471	1.22
Plaque index	0.33698	0.49530	0.6803	0.496	1.401	0.531	3.70
Bleeding index	-0.49690	0.35723	-1.3910	0.164	0.608	0.302	1.23
Platelet Count	9.95e-8	9.45e-7	0.1053	0.916	1.000	1.000	1.00
Neutrophil %	-0.00209	0.01021	-0.2044	0.838	0.998	0.978	1.02
Total Cholesterol	-0.00264	0.00436	-0.6042	0.546	0.997	0.989	1.01
Triglycerides	2.67e-4	0.00238	0.1122	0.911	1.000	0.996	1.00
HDL	-3.47e−4	0.01005	-0.0345	0.972	1.000	0.980	1.02
LDL	-0.00268	0.00472	-0.5681	0.570	0.997	0.988	1.01
Fasting glucose (FBS)	0.00221	0.00434	0.5094	0.610	1.002	0.994	1.01
Random Blood Glucose (RBS)	-0.00158	0.00354	-0.4469	0.655	0.998	0.992	1.01
HbA1c	0.16090	0.11002	1.4625	0.144	1.175	0.947	1.46

Note. Estimates represent the log odds of "Periodontal Diagnosis = Periodontitis" vs. "Periodontal Diagnosis = Gingivitis"

DISCUSSION:

This is a unique study comparing blood inflammatory biomarkers and glucose and lipid metabolism indexes across patients with different periodontal statuses, and those with good systemic health. It is interesting to note that, when compared to patients with periodontal health, patients with gingivitis and periodontitis did not significantly differ statistically in blood inflammatory biomarkers or various glucose and lipid metabolism indexes (CHO, TG, HDL, and GLU). However, the mean levels of these markers was relatively higher in the periodontally diseased group of patients compared to the healthy group. In comparisons between systemically healthy periodontitis patients and periodontally healthy controls, a few previous research have reported positive associations between glucose and lipid metabolism indexes and periodontitis.[29,31,32]A significant cross-sectional investigation found that a higher risk of localized of Stage II/III periodontitis was correlated with higher blood triglyceride levels.[33]but not for Cholesterol and HDL. Also, a large cohort research in the non-diabetic population found that increased glucose levels was a marker of increased periodontitis risk.[34]The findings of our

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study also provided additional evidence for the substantial correlation between fasting glucose levels, glycated hemoglobin and periodontal status.[35,36]

Studies have also indicated that in addition to the glucose and lipid metabolism indexes alone, the amount of serum lipoprotein antibodies[37,38], and the combination of these indexes[39] may function as indicators of severe periodontitis. Peripheral blood indices may function as biomarkers for periodontal inflammation, according to a number of investigations.[40-42]Our results with respect to neutrophil % are consistent with previous research that showed higher peripheral neutrophil count were associated with generalized aggressive periodontitis.[41,43]
However, it was unclear, how platelet parameters relate to periodontal health.[28,44]Our data regarding platelet counts are consistent with other research showing increased plateletcrit, MPV, and platelet distribution width in patients with periodontitis.[44]Furthermore, platelet levels are higher in severe periodontitis patients compared to mild and healthy controls.[45] This was not the case, though, with Zhan et al's conclusion that a higher degree of periodontal inflammation is associated with a lower Mean Platelet Volume.[46,47]One possible explanation for this discrepancy could be because the patients in these studies had varying degrees of periodontitis severity. It is possible that severe periodontal inflammation affects glucose and lipid metabolism indexes by inducing systemic inflammatory responses, as there are fair and clear associations between certain of these indices and blood inflammatory biomarkers.[48,49]It is widely acknowledged that systemic low-grade inflammation (SLGI) is promoted by periodontitis, that causes bacteria or their byproducts to enter the bloodstream.[50,51]One important connection between systemic illness and periodontal disease is thought to be SLGI.[52] Our results do suggest that neutrophils and platelets could be the mediators as their levels were slightly high in periodontally diseased individuals as compared to the healthy counterparts. The immune response brought on by periodontitis may account for neutrophil mediation.[49]Subgingival plaque causes the periodontal pocket to release low-level lipopolysaccharide into the peripheral circulation on a continuous, permanent basis. The neutrophils then exhibit hyperresponsiveness.[53] The development of neutrophil extracellular traps[54], cytotoxic neutrophil proteases and histones[55], and ulcers on the pocket epithelium may be the cause of endotoxemia and SLGI. Because platelets can directly interact with microorganisms and express many molecules involved in antigen recognition, an increase in both their quantity and activity has been reported after bacteremia caused by periodontitis.[56]Activated platelets are defined by a higher number of granules, a faster rate of collagen aggregation, a higher level of thromboxane A2, and a higher expression of glycoprotein I b and IIb/IIIa receptors.[45] They also have a higher level of systemic inflammatory burden[57]and a higher risk of adverse cardiovascular events.[58]

Our study population of 339 patients were sub grouped as periodontitis, gingivitis and periodontally healthy according to the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions,[59] This study depicts the characteristics of glucose and lipid metabolism in systemically healthy patients which is in contrast to previous studies that primarily focus on the relationship between diagnosed systemic diseases and periodontitis. Although a variety of metabolic imbalances may increase the likelihood of developing diseases in the future, the changes in the glucose and lipid metabolic indexes of the patients in our study still appeared to be within the medical reference range (including type 2 diabetes, lipid disorders, cardiovascular disease, hepatic steatosis, and other

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circulatory disorders, etc.).[60,61]

Serum lipid levels and systemic health—specifically, diabetes, cardiovascular disease, tissue repair ability, immune cell function, and serum levels of pro-inflammatory cytokines—are known to be causally related. However, through a process involving pro-inflammatory cytokines, alterations in immune cell function brought on by periodontitis may promote metabolic dysregulation of lipid metabolism.[19]It has been shown that the periodontal health of individuals with hypercholestrolemia and cardiovascular disease was noticeably worse than that of control patients. In a study examining the relationship between severe periodontal disease, hypercholesteroalaemia, and cardiovascular illness, Katz et al. discovered a strong correlation between individuals with hypercholesteroalaemia and CPITN scores of IV.[20]

While some studies found a correlation between periodontal disease and both total cholesterol and TG[62-64], others found a correlation between periodontitis and either TG[65], LDL[66], or both[66,67]. Another study found that the group with periodontitis had lower HDL and higher TG and LDL levels[68,69]. However, other research using comparatively small sample sizes (52–261) did not discover any correlation[70,71]. The discrepancies in study design, sample size, participant characteristics, methodology, diagnostic criteria for periodontal parameters, and definitions of lipid diseases could all be contributing factors to this disagreement.

Due to its dysregulatory effect on immune system cells and wound healing, hyperlipidemia makes a person more vulnerable to infections, including periodontitis. Polymorphonuclear leukocytes (PMNs), which have a protective role in the early response to periodontal infection, develop functional abnormalities as a result of hyperlipidemia[10]. The processes of wound-healing can be hampered by hyperlipidemia by intensifying the monocyte differentiation process, which alters macrophage subsets and releases cytokines near the wound site[72]. It has been shown that high cholesterol causes white blood cells (WBC) to become hyperactive. This, in turn, causes an increase in the generation of oxygen radicals, which have been linked to disease progression in periodontitis[10].

Consistent with these results, Moeintaghvai et al[73] found that in people with periodontal abnormalities, mean cholesterol and triglyceride levels were significantly higher than those with periodontal health. Their LDL and HDL levels were higher than those of the control group as well, though not significant. In another trial, Parsa et al[74]focused on the connection between periodontitis, blood cholesterol, and cardiovascular diseases. They sorted their study groups based on their age, gender, smoking habits, and diet and found that people with periodontitis had a higher level of blood cholesterol compared to healthy individuals. In two separate studies by Golpasandhagh et al[75] and Taleghani et al[64], the relationship between periodontitis and plasma lipids was evaluated and they showed that cholesterol and triglyceride levels in cases with chronic periodontitis were significantly higher than those in healthy individuals; LDL and HDL in the case group were higher as well but were not statistically significant. However, Valentaviciene et al[76]concluded that no connection exists between plasma levels of triglyceride, LDL, HDL, and cholesterol in people with gingivitis and in individuals suffering chronic periodontitis, which is inconsistent with the results of our study wherein HDL levels were higher in periodontally healthy patients and other lipid parameters were higher in the diseased individuals.

Limitations persist in spite of these encouraging outcomes. The current cross-sectional study design was

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unable to investigate the causal connections between periodontal status and blood indices. Therefore, in order to investigate the links between them further, prospective studies are required possibly including a component of disease severity for periodontitis based on staging and correlating the lipid, glycemic and blood indices to the disease severity.

CONCLUSION

Although the mean values of the blood, glycemic and lipid parameters were higher in periodontal disease groups as compared to periodontally healthy patients; no significant correlations were found in the 3 periodontal disease variants and blood, glycemic and lipid parameters with gender as the primary outcome variable. It would be interesting to further investigate other outcome variables and assess the correlation of these parameters.

REFERENCES

Hujoel PP, Kotsakis G, Hujoel IA. Dental Morbidities, Smoking, oral hygiene, and inflammatory bowel diseases. Clin Gastroenterol Hepatol. 2016;14(12):1840–1.

Papapanou PN, Susin C. Periodontitis epidemiology: is periodontitis underrecognized, over-diagnosed, or both? Periodontology 2000. 2017;75(1):45–51.

Eke PI, Thornton-Evans G, Dye B, Genco R. Advances in surveillance of periodontitis: the Centers for Disease Control and Prevention periodontal disease surveillance project. J Periodontol. 2012;83(11):1337–42.

Socransky S, Haffajee A, Cugini M, Smith C, Kent R Jr. Microbial complexes in subgingival plaque. J Clin Periodontol. 1998;25(2):134–44.

Friedewald VE, Kornman KS, Beck JD, Genco R, Goldfine A, Libby P, et al. The American Journal of Cardiology and Journal of Periodontology editors' consensus: periodontitis and atherosclerotic cardiovascular disease. J Periodontol. 2009;80(7):1021–32.

Wu Y-Y, Xiao E, Graves DT. Diabetes mellitus related bone metabolism and periodontal disease. Int J Oral Sci. 2015;7(2):63–72.

Bascones-Martinez A, Gonzalez-Febles J, Sanz-Esporrin J. Diabetes and periodontal disease. Review of the literature. Am J Dent. 2014;27(2):63–7.

Mealey BL, Oates TW. Diabetes mellitus and periodontal diseases. J Periodontol. 2006;77(8):1289–303.

The Ministry of Health. Statistics report 2015 [cited 2015 5th Nov]. Available from: http://www.moh.gov.sa/en/Ministry/Statistics/book/Pages/default.aspx.

Fentoğlu Ö, Öz G, Taşdelen P, Uskun E, Aykaç Y, Bozkurt FY. Periodontal status in subjects with hyperlipidemia. J Periodontol. 2009;80(2):267–73.

Izumi A, Yoshihara A, Hirotami T. The relationship between serum lipids and periodontitis in elderly non-smokers. J Periodontol. 2009;80:740-8.

Saxlin T, Suominen-Tipale L, Kattainen A, Marniemi J. Association between serum lipid levels and

ISSN:1624-1940
DOI 10.6084/m9.figshare.26129875
http://magellanes.com/

periodontol infection. J Clin Periodontol. 2008;35:1040-7.

Ansari Moghaddam S, Abbasi S, Sanei Moghaddam E, Ansari Moghaddam AR. Triglyceride and Cholesterol Levels in Patients With Chronic Periodontitis. Health Scope. 2015; 4(2): e19928.

[Cutler CW et al. J Periodontol. 1999; 70: 1429. [PMID: 10632517].

Cutler CW et al. J Periodontol.1999; 70: 1313. [PMID: 10588494].

Iacopino A & Mand Cutler CW. J Periodontol.71: 1375. [PMID: 10972656].

Cutler CW & Iacopino AM. J Int Acad Periodontol 2000; 5:47 [PMID: 12760504].

Olshansky SJ, et al. N Engl J Med. 2005 352:1138. [PMID: 15784668].

Iacopino AM & Cutler CW. J Periodontol.2000; 71: 1375. [PMID: 10972656].

Katz J et al. J Clin Periodontol. 2001; 28: 865. . [PMID: 11493357].

https://apps.who.int/iris/handle/10665/42330.

Loos BG, Periodontal medicine: work in progress! J Clin Periodontol 2016;43:470-471.

Hajishengallis G, Chavakis T, Local and systemic mechanisms linking periodontal disease and inflammatory comorbidities. Nat Rev Immunol 2021;21:426-440.

Loos BG, Craandijk J, Hoek FJ, Wertheim-van Dillen PM, van der Velden U, Elevation of systemic markers related to cardiovascular diseases in the peripheral blood of periodontitis patients. J Periodontol 2000;71:1528-1534.

Schenkein HA, Papapanou PN, Genco R, Sanz M, Mechanisms underlying the association between periodontitis and atherosclerotic disease. Periodontol 2000 2020;83:90-106.

Sun X, Meng H, Shi D, et al. Analysis of plasma calprotectin and polymorphisms of S100A8 in patients with aggressive periodontitis. J Periodontal Res 2011;46:354-360.

Lu R, Li W, Wang X, Shi D, Meng H, Elevated neutrophil-tolymphocyte ratio but not platelet-to-lymphocyte ratio is associated with generalized aggressive periodontitis in a Chinese population. J Periodontol 2021;92:507-513.

Romandini M, Laforí A, Romandini P, Baima G, Cordaro M, Periodontitis and platelet count: a new potential link with cardiovascular and other systemic inflammatory diseases. J Clin Periodontol 2018;45:1299-1310.

Nepomuceno R, Pigossi SC, Finoti LS, et al. Serum lipid levels in patients with periodontal disease: a meta-analysis and metaregression. J Clin Periodontol 2017;44:1192-1207.

Atieh MA, Faggion CM Jr, Seymour GJ, Cytokines in patients with type 2 diabetes and chronic

ISSN:1624-1940
DOI 10.6084/m9.figshare.26129875
http://magellanes.com/

periodontitis: a systematic review and meta-analysis. Diabetes Res Clin Pract 2014;104:e38-45.

Vadakkekuttical RJ, Kaushik PC, Mammen J, George JM, Does periodontal inflammation affect glycosylated haemoglobin level in otherwise systemically healthy individuals? A hospital based study. Singapore Dent J 2017;38:55-61.

George AK, Narayan V, Kurian N, Joseph AE, Anil S, A pilot study on glycemia and insulin resistance in patients with severe periodontitis. J Indian Soc Periodontol 2021;25:393-398.

Tsai K-Z, Su F-Y, Cheng W-C, Huang R-Y, Lin Y-P, Lin GM, Associations between metabolic biomarkers and localized stage II/III periodontitis in young adults: theCHIEF Oral Health study. J Clin Periodontol 2021;48:1549-1558.

Song TJ, Chang Y, Jeon J, Kim J, Oral health and longitudinal changes in fasting glucose levels: a nationwide cohort study. PLoS One 2021;16:e0253769.

Han K, Park J-B, Clinical implication of fasting glucose and systolic/ diastolic blood pressure on the prevalence of periodontitis in non-diabetic and non-hypertensive adults using nationally representative data. Exp Ther Med 2018;16:671-678.

Tegelberg P, Tervonen T, Knuuttila M, et al. Association of hyperglycaemia with periodontal status: results of the northern finland birth cohort 1966 study. J Clin Periodontol 2021;48: 24-36.

Montebugnoli L, Servidio D, Miaton RA, Prati C, Tricoci P, Melloni C, Poor oral health is associated with coronary heart disease and elevated systemic inflammatory and haemostatic factors. J Clin Periodontol 2004;31:25-29.

Shah R, Thomas R, Mehta DS, Oxidized-low density lipoprotein in gingival crevicular fluid of patients with chronic periodontitis: a possible link to atherogenesis. Acta Odontol Scand 2014;72:154-156.

Gomes-Filho IS, Santos PNP, Cruz SS, et al. Periodontitis and its higher levels of severity are associated with the triglyceride/high density lipoprotein cholesterol ratio. J Periodontol 2021;92:1509- 1521.

Beydoun HA,Hossain S, Beydoun MA,Weiss J, Zonderman AB, Eid SM, Periodontal disease, sleep duration, and white blood cell markers in the 2009 to 2014 National Health and Nutrition Examination Surveys. J Periodontol 2020;91:582-595.

Shi D, Meng H, Xu L, et al. Systemic inflammation markers in patients with aggressive periodontitis: a pilot study. J Periodontol 2008;79:2340-2346.

Zhan Y, Lu R, Meng H, Wang X, Hou J, Platelet activation and platelet-leukocyte interaction in generalized aggressive periodontitis. J Leukoc Biol 2016;100:1155-1166.

ISSN:1624-1940
DOI 10.6084/m9.figshare.26129875
http://magellanes.com/

Anand PS, Sagar DK, Mishra S, Narang S, Kamath KP, Anil S, Total and differential leukocyte counts in the peripheral blood of patients with generalised aggressive periodontitis. Oral Health Prev Dent 2016;14:443-450.

Ustaoglu G, Erdal E, İnanır M, Does periodontitis affect mean platelet volume (MPV) and plateletcrit (PCT) levels in healthy adults? Rev Assoc Med Bras (1992) 2020;66:133-138.

Mutthineni RB, Ramishetty A, Gojja P, Muralidaran G, Burle VVA, Platelet indices be a new biomarker for periodontal disease. Contemp Clin Dent 2021;12:289-293.

Wang Xe, Meng H, Xu L, Chen Z, Shi D, Lv D, Mean platelet volume as an inflammatory marker in patients with severe periodontitis. Platelets 2015;26:67-71.

Zhan Y, Lu R, Meng H, Wang X, Sun X, Hou J, The role of platelets in inflammatory immune responses in generalized aggressive periodontitis. J Clin Periodontol 2017;44: 150-157.

Tonetti MS, Van Dyke TE, Working group 1 of the joint EFPAAPw. Periodontitis and atherosclerotic cardiovascular disease: consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. J Clin Periodontol 2013;40 Suppl 14:S24-29.

Vitkov L, Muñoz LE, Knopf J, et al. Connection between periodontitis-induced low-grade endotoxemia and systemic diseases: neutrophils as protagonists and targets. Int J Mol Sci 2021;22:4647.

Hajishengallis G, Periodontitis: frommicrobial immune subversion to systemic inflammation. Nat Rev Immunol 2015;15:30-44.

Jepsen S, Suvan J, Deschner J, The association of periodontal diseases with metabolic syndrome and obesity. Periodontol 2000 2020;83:125-153.

Holmstrup P, Damgaard C, Olsen I, et al. Comorbidity of periodontal disease: two sides of the same coin? An introduction for the clinician. J Oral Microbiol 2017;9:1332710.

Aboodi GM, Goldberg MB, Glogauer M, Refractory periodontitis population characterized by a hyperactive oral neutrophil phenotype. J Periodontol 2011;82:726-733.

Magán-Fernández A, Rasheed Al-Bakri SM, O'Valle F, Benavides-Reyes C, Abadía-Molina F, Mesa F, Neutrophil extracellular traps in periodontitis. Cells 2020;9:1494.

NauseefWM,Proteases, neutrophils, and periodontitis: theNET effect. J Clin Invest 2014;124:4237-4239.

Bakogiannis C, Sachse M, Stamatelopoulos K, Stellos K, Platelet-derived chemokines in inflammation and atherosclerosis. Cytokine 2019;122:154157.

Laky M, Anscheringer I, Wolschner L, et al. Periodontal treatment limits platelet activation in patients with periodontitis—a controlled-randomized intervention trial. J Clin Periodontol 2018;45:1090-1097.

ISSN:1624-1940
DOI 10.6084/m9.figshare.26129875
http://magellanes.com/

Patti G, Di Martino G, Ricci F, et al. Platelet indices and risk of death and cardiovascular events: results from a large population-based cohort study. Thromb Haemost 2019;119:1773- 1784.

Caton JG, Armitage G, Berglundh T, et al. A new classification scheme for periodontal and peri-implant diseases and conditions—introduction and key changes from the 1999 classification. J Periodontol 2018;89 Suppl 1:S1-S8.

Mendrick DL, Diehl AM, Topor LS, et al. Metabolic syndrome and associated diseases: from the bench to the clinic. Toxicol Sci 2018;162:36-42.

Cecoro G, Annunziata M, Iuorio MT, Nastri L, Guida L, Periodontitis, low-grade inflammation and systemic health: a scoping review. Medicina (Kaunas) 2020;56:272.

Lösche W, Karapetow F, Pohl A, Pohl C, Kocher T. Plasma lipid and blood glucose levels in patients with destructive periodontal disease. J Clin Periodontol. 2000;27(8):537–41.

Hagh LG, Zakavi F, Hajizadeh F, Saleki M. The association between hyperlipidemia and periodontal infection. Iran Red Crescent Med J. 2014;16(12).

Taleghani F, Shamaei M, Shamaei M. Association between chronic periodontitis and serum lipid levels. Acta Med Iran. 2010;48(1):47-50.

Morita M, Horiuchi M, Kinoshita Y, Yamamoto T, Watanabe T. Relationship between blood triglyceride levels and periodontal status. Community Dent Health. 2004;21(1):32–6.

Katz J, Flugelman MY, Goldberg A, Heft M. Association between periodontal pockets and elevated cholesterol and low density lipoprotein cholesterol levels. J Periodontol. 2002;73(5):494–500.

Katz J, Chaushu G, Sharabi Y. On the association between hypercholesterolemia, cardiovascular disease and severe periodontal disease. J Clin Periodontol. 2001;28(9):865–8.

Penumarthy S, Penmetsa GS, Mannem S. Assessment of serum levels of triglycerides, total cholesterol, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol in periodontitis patients. J Indian Soc periodontology. 2013;17(1):30.

Nepomuceno R, Pigossi SC, Finoti LS, Orrico SR, Cirelli JA, Barros SP, et al. Serum lipid levels in patients with periodontal disease: a meta-analysis and meta-regression. J Clin Periodontol. 2017;44(12):1192–207.

Almeida Abdo J, Cirano FR, Casati MZ, Ribeiro FV, Giampaoli V, Viana Casarin RC, et al. Influence of dyslipidemia and diabetes mellitus on chronic periodontal disease. J Periodontol. 2013;84(10):1401–8.

Banihashemrad SA, Moeintaghavi A, Rafighdoost A. Relationship between cholesterol and triglyceride blood values and periodontal parameters in patients of Mashhad health center. NY State Dent J. 2008;74(5):65.

ISSN:1624-1940
DOI 10.6084/m9.figshare.26129875
http://magellanes.com/

Fatin Awartani B, Atassi F. Evaluation of periodontal status in subjects with hyperlipidemia. J Contemp Dent Pract. 2010;11(2).

Moeintaghavi A, Haerian-Ardakani A, Talebi-Ardakani M, Tabatabaie I. Hyperlipidemia in patients with periodontitis. J Contemp Dent Pract. 2005;3:78-85.

Parsa AR. Relationship between periodontitis,cholestrol level in blod and cardio vascular heart diseases. Karolina Institute. 2005;2:52.

GolPasand hagh L, Zakavi F, Hajizadeh F. Association between chronic periodontitis and hyperlipidemia. Ahwaz Medicine-Dental Journal. 2007; 8(2):231-8. Persian.

Valentaviciene G, Paipaliene P, Nedzelskiene I, Zilinskas J, Anuseviciene OV. The relationship between blood serum lipids and periodontal condition. Stomatologija. 2006;8(3):96-100.