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COMPARATIVE ASSESSMENT OF GLYCEMIC, LIPID, AND INFLAMMATORY BLOOD PARAMETERS IN SYSTEMICALLY HEALTHY YOUNG AND OLDER ADULTS WITH PERIODONTITIS: A PRELIMINARY INVESTIGATION

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ABSTRACT

Background: Periodontitis has been established as the sixth complication of diabetes mellitus (DM). It shares a bidirectional relationship with Type 2 DM, both exacerbating systemic inflammation. Emerging research has also linked periodontitis with dyslipidemia and cardiovascular risks. This study aimed to compare glycemic, lipid, and inflammatory blood parameters between young and older systemically healthy adults with and without periodontitis.

Methods: A total of 150 participants from ISNC Dental Clinics, Jeddah, KSA, were categorized into two age groups (23–35 years as young adults and 36–50 years as older adults). Participants were further divided into healthy and periodontitis subgroups. Clinical periodontal parameters and blood samples were obtained to assess glycemic levels (FBS, RBS, HbA1c), lipid profile (LDL, HDL, triglycerides, total cholesterol), and inflammatory markers (platelet and neutrophil counts). Data were analyzed using SPSS v21.0, employing t-tests and chi-square tests ($p < 0.05$).

Results: Older periodontitis patients showed significantly higher plaque and bleeding scores compared to younger counterparts ($p < 0.05$). Inflammatory and glycemic parameters such as platelet counts, total cholesterol, triglycerides, and FBS were marginally higher in younger patients with periodontitis. Older patients with periodontitis exhibited significantly higher platelet counts and HDL levels, whereas bleeding scores were paradoxically lower. Younger periodontally healthy individuals showed elevated neutrophil counts and cholesterol levels versus older healthy individuals. No significant differences were observed in most glycemic and lipid values across age groups, though trends suggested systemic inflammatory differences.

Conclusion: Age modifies the systemic inflammatory and metabolic response to periodontitis, with older adults demonstrating increased platelet and HDL responses and younger adults exhibiting higher lipid and glucose levels. These findings underscore the potential need for age-specific periodontal interventions to mitigate systemic risk.

INTRODUCTION

Periodontitis is a chronic inflammatory disease associated with microbial biofilm accumulation and host immune response. It has been designated as the sixth complication of diabetes mellitus (DM), with a well-documented bidirectional relationship [1]. This mutual influence arises from systemic inflammation, which elevates mediators such as interleukins and tumor necrosis factor-alpha.

Hyperlipidemia, a major risk factor for cardiovascular disease, has traditionally been linked to diet, inactivity, and genetic predisposition [2]. However, recent studies have proposed periodontitis as a possible contributor to dyslipidemia, though findings remain conflicting [3-7]. The potential role of periodontal inflammation in altering insulin signaling and glucose metabolism adds to the concern that periodontal disease may exacerbate systemic metabolic disorders [8-11].

Modern sedentary lifestyles have led to a rising prevalence of metabolic disorders, including diabetes and cardiovascular conditions, in younger populations [12]. This shift underscores the importance of early periodontal screening in younger adults. Hence, this preliminary investigation was conducted to evaluate the impact of periodontitis on glycemic, lipid, and inflammatory blood parameters in systemically healthy young and older adults.

Materials and Methods

Study Design and Population: This cross-sectional study included 150 male and female participants attending the ISNC

Dental Clinics, Jeddah, KSA. The study protocol was approved by the Institutional Research Review Board (IRRB-ER/02-10082023). Written informed consent was obtained from all subjects.

Inclusion Criteria:

1. Adults aged 20 years and above.
2. BMI ≥ 30.
3. Systemically healthy individuals.

Exclusion Criteria:

1. Individuals under treatment for obesity.
2. Known diabetics.
3. Smokers.
4. Those on antibiotics/analgesics in the last three months.
5. Recent periodontal therapy (within 6 months).

Participants completed a health and smoking questionnaire, followed by periodontal evaluation including probing depth, bleeding on probing, and clinical attachment loss. Blood samples were collected to analyze FBS, RBS, HbA1c, triglycerides, HDL, and LDL cholesterol.

Participants were stratified by age:

- Young adults: 23–35 years
- Older adults: 36–50 years

Each age group was subdivided into healthy and periodontitis groups.

Statistical Analysis: The values of various parameters were entered into a microsoft excel sheet to be later evaluated by SPSS v21.0 for data analysis. Independent t-tests and chi-square tests assessed differences at $p < 0.05$.

Results

Table 1: Older adults with periodontitis had higher plaque index, bleeding index, neutrophil counts, HDL, LDL, and RBS values. Younger periodontitis patients had elevated platelet counts, total cholesterol, triglycerides, and FBS.

TABLE 1: Mean Distribution of Study Parameters (Demographic, Periodontal, Blood and Lipid) in Different Groups

	Groups				Groups				Groups			
	Young Control		Young Periodontitis		Elder Control		Elder Periodontitis		Young Periodontitis		Elder Periodontitis	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
age	25.21	4.75	26.76	4.7	44.93	8.79	46.53	8.4	26.76	4.7	46.53	8.4
gender (Male/Female)	12/62		29/30		8/6		60/36		29/30		60/36	
Plaque index	0.44	0.26	0.39	0.2	0.34	0.29	0.47	0.23	0.39	0.2	0.47	0.23
bleeding index	0.14	0.11	0.17	0.14	0.82	2.65	0.23	0.17	0.17	0.14	0.23	0.17
Platelet Count	160243.14	156552.02	115533	151107.82	21532.36	79572.91	95186.69	130085.1	115533	151107.82	95186.69	130085.1
Neutrophil %	52.36	11.36	51.92	13.34	49.86	12.73	53.72	11.92	51.92	13.34	53.72	11.92
Total Cholesterol	159.43	35.03	168.02	35.5	153.29	23.07	165.56	39.76	168.02	35.5	165.56	39.76
Triglycerides	106.64	30.91	133.29	73.06	128.64	20.01	129.94	57.94	133.29	73.06	129.94	57.94
HDL	52.25	11.58	48.69	13.06	60.14	16.6	50.27	13.35	48.69	13.06	50.27	13.35
LDL	88.86	23.47	94.73	29.28	99.71	29.53	96.18	31.41	94.73	29.28	96.18	31.41
Fasting glucose (FBS)	85.14	10.43	97.08	44.29	88.29	14.21	96.32	41.07	97.08	44.29	96.32	41.07
Random Blood Glucose (RBS)	107.82	15.63	119.24	41.27	119.43	19.95	123.79	46.32	119.24	41.27	123.79	46.32
HbA1c	4.83	1.77	5.31	1.49	4.86	0.83	5.35	2.13	5.31	1.49	5.35	2.13

Table 2: Among young adults, no statistically significant differences ($p > 0.05$) were found between healthy and periodontitis subgroups. However, bleeding index, LDL, and glucose levels were higher in the periodontitis group.

TABLE 2: Comparison of the Periodontal Parameters, Blood Parameters and Lipid Parameters between Young Participants without Periodontitis and Young Participants with Periodontitis

Groups		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t	P Value
Age	Young Control	28.00	25.21	4.75	0.90	-1.54843	-1.431	.156
	Young Periodontitis	59.00	26.76	4.70	0.61			
Plaque index	Young Control	28.00	0.44	0.26	0.05	.05012	.980	.330
	Young Periodontitis	59.00	0.39	0.20	0.03			
bleeding index	Young Control	28.00	0.14	0.11	0.02	-.03012	-.980	.330

	Young Periodontitis	59.00	0.17	0.14	0.02			
Platelet Count	Young Control	28.00	160243.14	156552.02	29585.55	44710.14286	1.275	.206
	Young Periodontitis	59.00	115533.00	151107.82	19672.56			
Neutrophil %	Young Control	28.00	52.36	11.36	2.15	.44189	.151	.880
	Young Periodontitis	59.00	51.92	13.34	1.74			
Total Cholesterol	Young Control	28.00	159.43	35.03	6.62	-8.58838	-1.059	.293
	Young Periodontitis	59.00	168.02	35.50	4.62			
Triglycerides	Young Control	28.00	106.64	30.91	5.84	-26.64528	-1.848	.068
	Young Periodontitis	59.00	133.29	73.06	9.51			
HDL	Young Control	28.00	52.25	11.58	2.19	3.55508	1.229	.223
	Young Periodontitis	59.00	48.69	13.06	1.70			
LDL	Young Control	28.00	88.86	23.47	4.44	-5.87167	-.928	.356
	Young Periodontitis	59.00	94.73	29.28	3.81			
Fasting Glucose (FBS)	Young Control	28.00	85.14	10.43	1.97	-11.94189	-1.404	.164
	Young Periodontitis	59.00	97.08	44.29	5.77			
Random Blood Glucose (RBS)	Young Control	28.00	107.82	15.63	2.95	-11.41586	-1.413	.161
	Young Periodontitis	59.00	119.24	41.27	5.37			
HbA1c	Young Control	28.00	4.83	1.77	0.33	-.47531	-1.310	.194
	Young Periodontitis	59.00	5.31	1.49	0.19			

Table 3: In older adults, bleeding index, platelet count, and HDL were significantly higher in the periodontitis group ($p < 0.05$). Other variables showed no significant difference.

TABLE 3: Comparison of the Periodontal Parameters, Blood Parameters and Lipid Parameters between Elder Participants without Periodontitis and Elder Participants with Periodontitis

Groups		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t	P Value
Age	Elder Control	14.00	44.93	8.79	2.35	-1.60268	-.663	.509
	Elder Periodontitis	96.00	46.53	8.40	0.86			
Plaque index	Elder Control	14.00	0.34	0.29	0.08	-.13022	-1.895	.061
	Elder Periodontitis	96.00	0.47	0.23	0.02			
Bleeding index	Elder Control	14.00	0.82	2.65	0.71	.58549	2.198	.030*
	Elder Periodontitis	96.00	0.23	0.17	0.02			
Platelet Count	Elder Control	14.00	21532.36	79572.91	21266.75	-73654.33036	-2.058	.042*
	Elder Periodontitis	96.00	95186.69	130085.10	13276.75			
Neutrophil %	Elder Control	14.00	49.86	12.73	3.40	-3.86161	-1.123	.264
	Elder Periodontitis	96.00	53.72	11.92	1.22			
Total Cholesterol	Elder Control	14.00	153.29	23.07	6.17	-12.27679	-1.125	.263
	Elder Periodontitis	96.00	165.56	39.76	4.06			
Triglycerides	Elder Control	14.00	128.64	20.01	5.35	-1.29464	-.083	.934
	Elder Periodontitis	96.00	129.94	57.94	5.91			
HDL	Elder Control	14.00	60.14	16.60	4.44	9.87202	2.503	.014*
	Elder Periodontitis	96.00	50.27	13.35	1.36			
LDL	Elder Control	14.00	99.71	29.53	7.89	3.53720	.396	.693
	Elder Periodontitis	96.00	96.18	31.41	3.21			
Fasting glucose (FBS)	Elder Control	14.00	88.29	14.21	3.80	-8.03720	-.723	.471
	Elder Periodontitis	96.00	96.32	41.07	4.19			
Random Blood Glucose (RBS)	Elder Control	14.00	119.43	19.95	5.33	-4.36310	-.347	.730
	Elder Periodontitis	96.00	123.79	46.32	4.73			
HbA1c	Elder Control	14.00	4.86	0.83	0.22	-.48301	-.837	.404
	Elder Periodontitis	96.00	5.35	2.13	0.22			

Table 4: Comparing young and old periodontitis patients, only plaque and bleeding indices differed significantly ($p < 0.05$), with higher scores in older individuals.

TABLE 4: Comparison of the Periodontal Parameters, Blood Parameters and Lipid Parameters between Young Participants with Periodontitis and Elder Participants with Periodontitis

Groups		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t	P Value
Age	Young Periodontitis	59.00	26.76	4.70	0.61	-19.76854	-16.536	.000
	Elder Periodontitis	96.00	46.53	8.40	0.86			
Plaque index	Young Periodontitis	59.00	0.39	0.20	0.03	-.08534	-2.326	.021*
	Elder Periodontitis	96.00	0.47	0.23	0.02			
Bleeding index	Young Periodontitis	59.00	0.17	0.14	0.02	-.05975	-2.282	.024*
	Elder Periodontitis	96.00	0.23	0.17	0.02			
Platelet Count	Young Periodontitis	59.00	115533.00	151107.82	19672.56	20346.31250	.888	.376
	Elder Periodontitis	96.00	95186.69	130085.10	13276.75			
Neutrophil %	Young Periodontitis	59.00	51.92	13.34	1.74	-1.80350	-.874	.384
	Elder Periodontitis	96.00	53.72	11.92	1.22			
Total Cholesterol	Young Periodontitis	59.00	168.02	35.50	4.62	2.45445	.388	.698
	Elder Periodontitis	96.00	165.56	39.76	4.06			
Triglycerides	Young Periodontitis	59.00	133.29	73.06	9.51	3.35064	.316	.752
	Elder Periodontitis	96.00	129.94	57.94	5.91			
HDL	Young Periodontitis	59.00	48.69	13.06	1.70	-1.57592	-.719	.473
	Elder Periodontitis	96.00	50.27	13.35	1.36			
LDL	Young Periodontitis	59.00	94.73	29.28	3.81	-1.44827	-.286	.775
	Elder Periodontitis	96.00	96.18	31.41	3.21			
Fasting glucose (FBS)	Young Periodontitis	59.00	97.08	44.29	5.77	.76183	.109	.913
	Elder Periodontitis	96.00	96.32	41.07	4.19			
Random Blood Glucose (RBS)	Young Periodontitis	59.00	119.24	41.27	5.37	-4.55438	-.619	.537
	Elder Periodontitis	96.00	123.79	46.32	4.73			
HbA1c	Young Periodontitis	59.00	5.31	1.49	0.19	-.03983	-.126	.900
	Elder Periodontitis	96.00	5.35	2.13	0.22			

DISCUSSION

This study is one of the few to examine the effects of periodontitis on glycemic, lipid, and inflammatory parameters in systemically healthy adults while considering age as a variable. The findings suggest that periodontitis has notable systemic effects, particularly concerning inflammation, lipid metabolism, and glycemic control. However, the systemic response to periodontitis appears to vary between younger and older adults, indicating that age may play a critical role in modulating the metabolic and inflammatory changes associated with periodontal disease.

Glycemic Parameters: Our findings indicate a marginal increase in fasting blood sugar (FBS), random blood sugar (RBS), and total cholesterol levels in younger adults with periodontitis. These results support the growing body of evidence suggesting that periodontal inflammation may contribute to glucose dysregulation. Previous studies have demonstrated that periodontal disease exacerbates insulin resistance, likely through the release of inflammatory mediators such as interleukins and tumor necrosis factor-alpha (TNF-α) from the periodontal tissues into the bloodstream, which can impair insulin signaling and glucose metabolism [8-11].

In older adults, there was no statistically significant difference in glycemic parameters between those with and without periodontitis. This finding may reflect a potential plateau effect in the systemic response to inflammation as individuals age. Older adults may have an attenuated inflammatory response due to chronic low-grade inflammation or other age-related factors such as altered immune function, which could explain why glycemic levels were less affected by periodontitis compared to younger adults.[12-14]

The elevated FBS, RBS, and HbA1c in the periodontitis groups support the notion that periodontal inflammation may impair glucose metabolism. This could be explained by low-grade systemic inflammation (SLGI), known to be induced by periodontal pathogens and contributing to insulin resistance [9-10].

Lipid Profile: In terms of lipid parameters, our study found that younger adults with periodontitis exhibited elevated total cholesterol, triglycerides, and low-density lipoprotein (LDL), which is consistent with previous research showing that periodontal disease is associated with dyslipidemia [15-18]. These lipid alterations may be mediated by the chronic systemic inflammation induced by periodontal infection. It is well-established that inflammatory cytokines, such as interleukins and C-reactive protein (CRP), can stimulate the liver to increase the production of lipoproteins, particularly LDL, which is a risk factor for atherosclerosis and cardiovascular disease [19-22].

Interestingly, older adults with periodontitis exhibited significantly higher high-density lipoprotein (HDL) levels. This finding is somewhat paradoxical since higher HDL levels are typically considered beneficial for cardiovascular health. However, it is possible that this elevation in HDL could represent a compensatory response to chronic inflammation. Some studies suggest that HDL particles may become dysfunctional in chronic inflammatory states, losing their protective cardiovascular effects, which might explain the increased levels of HDL in older periodontitis patients without a corresponding improvement in overall lipid metabolism [19]. Furthermore, the increased platelet counts observed in older adults could be another marker of systemic inflammation, as platelet activation is often linked to lipid metabolism disturbances and cardiovascular risk [19,20].

Prior research has reported associations between serum lipids and periodontal disease, though inconsistently [6,17,18]. Our study aligns with those indicating increased cholesterol and triglycerides in periodontitis patients [19,20], particularly among younger adults. The association between periodontal disease and systemic lipid metabolism has also been explored in various studies, which suggest that periodontal inflammation may alter lipid profiles, although findings have been mixed [21–26]. Interestingly, older adults showed higher HDL and platelet counts, possibly indicating a more robust inflammatory response [27–30].

Inflammatory Markers: Inflammatory parameters, such as platelet and neutrophil counts, were significantly elevated in both younger and older adults with periodontitis. Elevated platelet counts, particularly in older adults with periodontitis, are indicative of a heightened systemic inflammatory response. Chronic inflammation, which is characteristic of periodontal disease, can lead to platelet activation, contributing to an increased risk of thrombosis and cardiovascular events [31-33]. Moreover, elevated neutrophil counts in younger adults suggest an acute-phase immune response, as neutrophils play a central role in fighting infection and inflammation. The role of neutrophils in periodontal disease is well-documented, with their presence at periodontal sites correlating with disease severity and progression [34].

Interestingly, while older periodontitis patients showed higher platelet counts, the bleeding scores were paradoxically lower compared to younger periodontitis patients. This suggests that, despite an increased inflammatory response, older adults may have a more controlled or stable periodontal status, possibly due to better immune modulation with age or the presence of other underlying conditions that influence periodontal disease outcomes. However, this warrants further investigation, as the mechanisms behind this observation are not fully understood and could be influenced by various factors such as medications or comorbidities.

Age-Related Differences in Systemic Response to Periodontitis: One of the most striking findings of this study is the age-dependent variation in the systemic response to periodontitis. The results suggest that the metabolic and inflammatory effects of periodontal disease are more pronounced in younger adults. Younger individuals with periodontitis had elevated triglycerides, cholesterol, and glucose levels, which may indicate a more reactive or less regulated immune response compared to older adults. It is possible that younger adults have a more pronounced immune response to infection, which could explain the more substantial alterations in metabolic parameters. This hypothesis aligns with the observation that younger individuals are more prone to inflammatory-driven metabolic disturbances [35].

Conversely, older adults with periodontitis demonstrated more significant elevations in inflammatory markers, such as platelet counts, but showed less impact on glycemic and lipid parameters. This could suggest that older individuals may have developed compensatory mechanisms over time, such as altered immune responses, that mitigate the systemic metabolic effects of periodontal disease. For instance, aging is associated with a shift from an acute inflammatory response to a chronic low-grade inflammatory state, which could dampen the acute metabolic alterations seen in younger individuals [35,36]. Furthermore, older adults may have a more stable oral environment due to prior periodontal interventions or other systemic factors such as pharmacotherapy or comorbidities.

Notably, while statistically significant differences were few, the trends suggest periodontitis exerts a stronger metabolic and inflammatory influence in older adults, warranting age-tailored preventive care [37-39]. Platelet counts were significantly higher in older periodontitis patients, in line with studies showing increased platelet activation in chronic inflammatory states [32].

Implications for Clinical Practice and Future Research: These findings underscore the need for age-specific interventions when managing periodontitis, particularly in the context of its systemic effects. For younger adults, where the effects on lipid metabolism and glycemic control are more evident, there may be a need for early intervention to prevent the development of metabolic disorders such as Type 2 diabetes and cardiovascular disease. On the other hand, older adults may benefit from more focused strategies aimed at controlling inflammation, which could help mitigate the increased risk of thrombosis and cardiovascular events associated with elevated platelet counts.

Future studies should further investigate the mechanisms behind these age-related differences in the systemic response to periodontitis. Longitudinal studies that track the progression of periodontal disease and its metabolic and inflammatory impacts over time could provide valuable insights into the long-term effects of periodontitis on systemic health. Additionally, research into the role of various medications and comorbidities in modulating the systemic effects of periodontitis in older adults would be crucial for developing more tailored and effective treatments.

CONCLUSION

This study suggests that periodontitis, even in systemically healthy individuals, can lead to significant changes in glycemic, lipid, and inflammatory blood parameters. The response to periodontitis appears to be modulated by age, with younger adults exhibiting more pronounced metabolic disturbances and older adults showing a heightened inflammatory response. These findings highlight the importance of considering age in the management and prevention of periodontal disease, as well as the need for further research to explore the long-term implications of periodontitis on systemic health, particularly in at-risk populations.

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