

A 3-way analysis between Body Mass Index, Lipid Profile and Periodontal Parameters: A cross sectional study

¹Dr.Shivendra Pal Singh, M.D.S., Assistant Professor, Department of Periodontology & Implantology, Mahatma Gandhi Dental College, Jaipur, India,

²Dr.Nidhi Rathore, M.D.S., Associate Professor, Department of Orthodontics, NIMS Dental College, Jaipur, India

³Dr.Mridula Trehan, M.D.S., Principal & HOD , Department of Orthodontics, NIMS Dental College, Jaipur, India,

⁴Dr.Ashish Yadav, M.D.S., Professor, Department of Periodontology & Implantology, Mahatma Gandhi Dental College Jaipur, India,

⁵Dr.Jagrati Singh, M.D.S., Senior Lecturer, Department of Pedodontics, Pacific Dental College and Research Centre, Udaipur, India,

⁶Dr.Pulak Mishra, M.D.S., Consultant Periodontist, New Delhi, India,

Corresponding Author: Dr. Shivendra Pal Singh, M.D.S., Assistant Professor, Department of Periodontology & Implantology, Mahatma Gandhi Dental College, Jaipur, India,

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Abstract

Overweight and obesity represent a rapidly growing threat to the health of populations and an increasing numbers of countries worldwide. Obesity has been found to be associated with periodontal infection, which means that body weight could be a confounding factor in the association between hyperlipidaemia and periodontal infection. Hence, this study is carried out to find the relationship between Body Mass Index (BMI), Lipid Profile and Periodontal Parameters.

Summary: This study revealed significant correlation of total cholesterol, LDL and Triglycerides with all the groups based on Body Mass Index. However, the

correlation between HDL and all the three groups was found to be no significant.

Keyword: body mass index, lipid profile, obesity

Introduction

Obesity today is not simply an esthetic and social problem but is considered as a life threatening disorder.^{1,2,3} Currently it is one of the leading causes of health concerns globally. Obesity today is well known to be a significant risk factor for various adult diseases. Acute infections are known to interfere with lipid metabolism and elevation of plasma triglycerides has been observed especially in infection with gram-negative bacteria. These changes are thought to be mediated by cytokines, which are produced

in the inflamed periodontal tissue in high quantities.⁴ Obesity has been found to be associated with periodontal infection, which means that body weight could be a confounding factor in the association between hyperlipidaemia and periodontal infection.⁵ Hence, this study is carried out to find the relationship between Body Mass Index (BMI), Lipid Profile and Periodontal Parameters.

Subjects and Methods

A random sample of 75 patients for this study was selected from our outpatient department. The nature of the study was explained to the subjects and written consent was obtained. A detailed systemic history-taking was followed by measurement of Weight and Height. Clinical examination of subjects was then performed on all existing teeth, and periodontal conditions were evaluated. Peripheral blood samples were then obtained from each subject and the sera were isolated by centrifugation after clotting. Samples were then divided into small portions, coded and stored until use. Serum Total Cholesterol, High density lipoproteins, Low density lipoproteins and Triglycerides were estimated using commercially available kits in the biochemistry laboratory. All obtained data was put to statistical analysis for correlative study.

Clinical protocol

Inclusion criteria

1. Age group between 18-60 years
2. Patients without any systemic disease.
3. At least 4 teeth per quadrant i.e. minimum 16 teeth present.

Exclusion Criteria

1. Immunocompromised patient
2. Pregnant women
3. Lactating mothers.
4. Patients with smoking and tobacco chewing habit.
5. Patient under any medication

6. Periodontal therapy in past 6 months.
7. History of acute infection in past 6 months.

Study Design

a) Clinical Study Design: This was a cross-sectional double blind study. The examiners were not aware of the biochemical parameters of the patients and the laboratory technicians were not aware of the periodontal status of the patients. The study design was reviewed and approved by the Ethical Committee of our college.

b) Estimation of Body Mass Index ⁶: It was calculated as the ratio of weight (kilograms) to the square of height (meters).

c) Evaluation of standard clinical parameters: Full mouth examination (excluding third molars) was conducted for all patients. The presence of dental plaque was examined with the help of dental explorer and the presence or absence was noted. Six sites were examined for each tooth (mid-buccal, mesiobuccal, distobuccal, midlingual, mesiolingual and dentilingual). Clinical parameters recorded were:

1. Probing pocket depth
2. Clinical attachment level
3. Gingival Index⁷

c) Blood collection

Under aseptic measures, venous blood samples were drawn by venipuncture in antecubital fosse between 9:00 am and 12:00 pm using a 5-ml disposable syringe, collected into tubes and transported to the biochemistry laboratories, respectively for analyses within 3 hours after collection.

Estimation of Serum Lipids⁸

1. Estimation of Serum Total Cholesterol was done using commercially available CHOLESTEROL EP LS kit by CHOD-PAP method.

2. Estimation of Serum HDL Cholesterol was done using commercially available HDL Cholesterol ppt. set marketed by PEG precipitation method.

3. Estimation of Serum Triglyceride was done using commercially available TRIGLYCERIDES PAP kit marketed by Enzymatic Colorimetric Method (PAP).

4. Estimation of Serum LDL Cholesterol is done by the following formula;

Friedewald’s formula

$$\text{LDL cholesterol} = \text{Total Cholesterol} - (\text{HDL} + \text{TG}/5)$$

Table 1: Comparison of Age with different BMI groups

		BMI			Total
		Healthy	Overweight	Obese	
<=35 Yrs	Count	13	7	11	31
	% within BMI	52.00%	28.00%	44.00%	41.30%
>35 Yrs	Count	12	18	14	44
	% within BMI	48.00%	72.00%	56.00%	58.70%
Total	Count	25	25	25	75
	% within BMI	100.00%	100.00%	100.00%	100.00%
Pearson Chi-Square			3.079	p-value	0.214

Table 2 shows that male subjects are more compared to females but there was no significant difference (p-value=0.402) of gender with healthy, overweight and

Table 2: Comparison of Gender with different BMI groups

Gender		BMI			Total
		Healthy	Overweight	Obese	
Male	Count	13	17	17	47
	% within BMI	52.00%	68.00%	68.00%	62.70%
Female	Count	12	8	8	28
	% within BMI	48.00%	32.00%	32.00%	37.30%
Total	Count	25	25	25	75
	% within BMI	100.00%	100.00%	100.00%	100.00%
Pearson Chi-Square			1.824	p-value	0.402

Results

In the present study, evaluation of periodontal parameters in different types of obese, overweight and healthy subjects was done and also the correlation between periodontal parameters, lipid profile and body mass index was analysed. Seventy five subjects participated in our study with an age range of 18 to 60 years old. Statistically there was no significance (p-value =0.214) of age with the BMI. (Table 1)

obese groups. The dental plaque was seen in almost all of the teeth where gingival bleeding and periodontal pockets were present.

Table 3 shows statistical results of various periodontal parameters viz. Gingival Index, Probing pocket depth and Clinical attachment level with all the groups based on body mass index. All the 3 periodontal parameters, GI, PPD and CAL shows significant differences with body mass index (p value 0.001, 0.008 and <0.001 respectively) in all the groups. On multiple comparison analysis, it was found out that the correlation for GI, PPD and CAL was highly significant only when healthy and obese group

were compared (p value 0.001, 0.006, <0.001 respectively). However, when healthy group was compared with overweight and overweight group was compared with obese group, the results were found to be non significant for all the periodontal parameters with an exception of GI that showed significant difference when healthy group was compared with overweight group. (P-value = 0.028)

Table 3: Periodontal parameters in Healthy, Overweight and Obese groups

Variables	Group	N	Mean	Std. Deviation	F value	p-value	Multiple Comparison	p-value
GI	Healthy	25	1.32	0.64	7.348	0.001*	Healthy vs Overwt	0.028*
	Overweight	25	1.84	0.76			Healthy vs Obese	0.001*
	Obese	25	2.04	0.66			Over wt vs Obese	0.895
	Total	75	1.73	0.75				
PPD	Healthy	25	3.05	0.75	5.213	0.008*	Healthy vs Overwt	0.241
	Overweight	25	3.44	0.88			Healthy vs Obese	0.006*
	Obese	25	3.76	0.70			Over wt vs Obese	0.454
	Total	75	3.42	0.82				
CAL	Healthy	25	3.20	1.00	8.992	<0.001*	Healthy vs Overwt	0.117
	Overweight	25	3.84	1.21			Healthy vs Obese	<0.001*
	Obese	25	4.48	0.96			Over wt vs Obese	0.107*
	Total	75	3.84	1.17				

Statistically significant difference at p value <0.05

Table 4 shows statistical results of lipid profile with all the groups. Our study revealed significant association of total Cholesterol, LDL, Triglycerides with all the groups based on Body Mass Index (p-value <0.001, <0.001 and 0.003). On multiple comparison analysis using Bonferroni test, the above three lipid profile parameters showed significant differences when healthy group was compared with obese group (p -value <0.001, <0.001 and 0.003 respectively for total cholesterol, LDL and triglycerides) and when

overweight group was compared with obese group (p-value <0.001, <0.001 and 0.031 respectively for total cholesterol, LDL and triglycerides). However, the association between HDL and all the three groups was found to be non-significant (p-value 0.6). On multiple comparison analysis also, the statistical difference of HDL with all the groups was found to be nonsignificant (p -value 1.0 for all comparison between the healthy, overweight and obese group).

Table 4: Lipid profile in Healthy, Overweight and Obese groups

		N	Mean	Std. Deviation	F-value	p-value	Multiple Comparison	p-value
Total Cholestrol	Healthy	25	159.56	33.96	27.041	<0.001*	Healthy vs Overwt	1.00
	Overweight	25	157.80	37.27			Healthy vs Obese	<0.001*
	Obese	25	227.41	42.75			Over wt vs Obese	<0.001*
	Total	75	181.59	49.82				
HDL	Healthy	25	45.14	13.76	0.515	0.6	Healthy vs Overwt	1.00
	Overweight	25	42.32	13.53			Healthy vs Obese	1.00
	Obese	25	45.53	8.69			Over wt vs Obese	1.00
	Total	75	44.33	12.14				
LDL	Healthy	25	98.69	40.20	17.35	<0.001*	Healthy vs Overwt	1.00
	Overweight	25	94.99	27.75			Healthy vs Obese	<0.001*
	Obese	25	160.07	58.22			Over wt vs Obese	<0.001*
	Total	75	117.92	52.69				
Triglycerides	Healthy	25	104.64	36.15	6.463	0.003*	Healthy vs Overwt	1.00
	Overweight	25	117.78	45.00			Healthy vs Obese	0.003*
	Obese	25	161.15	82.56			Over wt vs Obese	0.031*
	Total	75	127.86	62.30				

Statistically significant difference at p value <0.05

Table 5 shows significant difference between all the three periodontal parameters viz. GI, PPD, CAL with total cholesterol, LDL and triglycerides. Total cholesterol showed statistical significance and positive correlation with GI (r =0.394, p-value <0.001), PPD (r =0.383, p-value 0.001) and CAL (r =0.418, p-value <0.001). A statistically significant and positive correlation was also seen between LDL with GI (r =0.317, p-value 0.006), PPD

(r =0.323, p-value 0.005) and CAL (r =0.343, p-value 0.003). Triglycerides also showed statistical significance and positive correlation with GI (r =0.350, p-value 0.002), PPD(r =0.337, p-value 0.003) and CAL (r =0.349 p-value 0.002). However, HDL failed to show a significance and positive correlation with GI (r =0.091, p-value 0.437), PPD (r =0.184, p-value 0.114) and CAL (r=0.157, p-value 0.180)

Table 5: Correlations between lipid parameters and periodontal parameters

Periodontal Parameters	Total Cholesterol		HDL		LDL		Triglycerides	
	r	p value	r	p value	r	p value	r	p value
GI	0.394**	<0.001	0.091	0.437	0.317**	0.006	0.350**	0.002
PPD	0.383**	0.001	0.184	0.114	0.323**	0.005	0.337**	0.003
CAL	0.418**	<0.001	0.157	0.180	0.343**	0.003	0.349**	0.002

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Discussion

Periodontitis is an infectious disease in which immune responses play an vital role. Many systemic conditions affecting inflammatory status have been suggested to be related to the development of periodontitis which include overweight and obesity.^{5,9,10,11,12}

In current study, the correlation between BMI and periodontal parameters were investigated in order to obtain evidence about the nature of this association. We found that overweight and obesity were associated with higher incidence of deepened periodontal pockets and more clinical attachment loss. These results are in line with the findings of previous cross-sectional studies which have suggested that obesity is a risk factor for periodontal infection, although the strength of the association was slightly weaker than that presented in two recent meta-analyses by Chaffee & Weston¹³ & Suvan et al.¹⁴.

A similar association was also found when obesity was defined using Body Fat Percentage or Waist Circumference. Despite the fact that only few studies on the association of periodontal infection to obesity exist, the results of the present study were in accordance with the findings of a study by D'Aiuto et al.¹⁵, in which moderate and severe periodontal parameters were associated with metabolic syndrome and central obesity as an individual component of the condition.

Periodontal infection has earlier been suggested to be associated with cardiovascular disease.^{16,17,18} In light of the findings of the present study, it is also possible that the association of periodontal infection with CVD may be more complex than previously assumed, with part of the effect of periodontal infection on CVD mediated through the effect of periodontal infection on weight gain. However, since obesity seems to be associated with a risk of both periodontal infection and CVD, it is also possible

that the association of periodontal infection with CVD is confounded by obesity.

Hyperlipidaemia is often associated with obesity. Besides the effects on atherogenesis, serum lipids, more precisely triglycerides and LDL-C, have also been suggested to possess proinflammatory properties^{19,20,21}. HDL-C, on the other hand, has been suggested to be anti-inflammatory.²²

Therefore, hyperlipidaemia could possibly act as a mediating mechanism in the association between obesity and periodontal infection. Our study showed higher values of GI and higher mean values of PPD and CAL in the overweight and obese group than in the healthy group. It also showed that there is a positive association between total cholesterol, LDL with the value of GI, PPD and CAL. An association between triglycerides and GI, PPD and CAL also were significant. This suggests that hyperlipidemia may be a potential risk factor for periodontal disease which is similar to study done by Fentoglu et al.²³ The result of our study showed no association between HDL and periodontal parameters which were in accordance with a study done by Gomaschi et al.²²

Clinical studies that examine the association between blood lipid levels and periodontal disease are controversial. Some report an association between cholesterol and periodontal parameters;²⁴ others report an association between triglycerides and periodontal parameters.²⁵

Our study reported an association between total cholesterol, LDL, and triglycerides with clinical parameters; this positive correlation indicates that both variables increase or decrease together. This was in agreement with the results of Losche et al.²⁶

Bodyweight could be a mediating factor through which serum lipids can exert effect on the periodontium. Saxlin

et al²⁷ conducted a study to understand the role of body weight in this association between serum lipids and periodontal infection wherein the data was stratified by BMI. The results of the study showed no clear association between serum lipid levels and the number of teeth with deepened periodontal pockets (4mm or more) among subjects with BMI <25. There was an association of high serum triglycerides and low HDL with obese subjects and the same results were also found in this present study.

Hyperlipidemia with abnormally elevated levels of any or all lipids and/or lipoproteins in the blood ; is known to be associated with periodontitis.²⁸ The results were in accordance to our study which also showed a possible relationship between plasma lipid levels and periodontal disease.

A study done by A V Saravanan et al²⁹ & Rane JS³⁰ et al suggested an association between serum cholesterol and periodontal disease which is in accordance to our study.

However, the present study had some limitations as there were a limited number of patients that participated in the study. Therefore, further longitudinal studies of larger populations are necessary to be able to further establish the true relationship between hyperlipidemia and periodontitis.

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