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### Impact of metabolic syndrome on the risk of Periodontal disease: An analysis by two different assessment tools

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**Abstract:****Background:**

Periodontal disease is a multifactorial disease with a large number of factors contributing to the disease. Metabolic syndrome is one such disease that has a bidirectional relationship with periodontal disease. Risk assessment tools are simple ways to assess the risk for a specific disease.

**Aim:**

To find the impact of metabolic syndrome on the risk of periodontal disease by two different risk assessment tools PRA (Periodontal risk assessment) and UniFe for periodontal risk assessment.

**Materials and methods:**

For a total of 60 patients factors for metabolic syndrome such as waist circumference, blood pressure, fasting blood glucose, triglyceride levels, and high-density lipoprotein (HDL) levels were assessed. The risk for periodontal disease was assessed for all the patients in PRA and UniFe and is co-related with the factors of metabolic syndrome.

**Results:**

A strong correlation between the factors of metabolic syndrome and periodontal disease risk was found in both the assessment tools (p value<0.05) and a statistically significant correlation between both the tools was also found (p value< 0.05).

**Conclusion:**

Metabolic syndrome is found to be a strong risk factor for periodontal disease. Risk assessment tools are simple, reliable methods to assess the risk of a specific disease.

**Keywords:** metabolic syndrome, risk assessment, hyperlipidemia, dysglycemia, hypertension.

**Introduction:**

Periodontal disease is a multifactorial disease caused by the interplay of microorganisms and inflammatory responses resulting in the damage of the supporting structures of the teeth<sup>1</sup>. Risk can be defined as the probability that an individual can acquire a disease. Metabolic syndrome can be defined as a group of conditions that can increase the risk of diabetes mellitus and heart disease<sup>3</sup>. Metabolic syndrome can be characterized by abdominal obesity, dyslipidemia, hypertension, and insulin resistance<sup>4</sup>. National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III)<sup>5</sup> proposed diagnostic criteria for metabolic syndrome, which includes any 3 or more criteria among waist circumference  $\geq 90$  cm (male),  $\geq 80$  cm (female), Triglyceride levels  $\geq 150$  mg/dl, HDL cholesterol  $\leq 40$  mg/dl, Blood pressure  $\geq 135/85$ , fasting blood glucose  $\geq 100$  mg/dl. Metabolic syndrome has been regarded as having a bidirectional relationship with periodontal disease since the inflammatory burden is being increased in both ways<sup>6</sup>. So far only a few studies are being done to determine the risk of periodontal disease for patients with metabolic syndrome. This study aims to find whether there is an association between abdominal obesity, dyslipidemia, hypertension, and insulin resistance in periodontal disease by routine blood investigation and two different assessment tools.

**Materials and methods:**

The proposed study was approved by the Ethical Committee of Sree Balaji Dental College and Hospital (SBDCH/IEC/12/2020/06). The study included 60 patients coming to the outpatient department of periodontics at Sree Balaji Dental College and hospital. Both male and female patients  $>35$  years of age who did not undergo periodontal treatment in the past 6 months were taken for the study. For all the patients included in the study, waist circumferences and blood pressure were recorded, followed by a complete medical history, smoking habits, oral hygiene practices, and periodontal examination, and the patients were diagnosed according to the 2017 classification of periodontal disease. A routine blood investigation, which included triglyceride levels, HDL levels, and fasting blood glucose, was carried out. All the records obtained from the examination were transferred to the Periodontal Risk Assessment<sup>7</sup> and UniFe<sup>8</sup>.

For Periodontal risk assessment<sup>7</sup>, online tool data for six different parameters are needed which include the Number of sites with bleeding on probing, smoking status of the patient, presence of genetic/systemic illness (diabetes), number of residual pockets with  $\geq 5$  mm, loss of periodontal

support pertaining to the age of the patient and the total number of teeth lost irrespective of the cause(fig:1). All these data acquired from the patient charts were then incorporated into the PRA tool which categorizes the patients as either low, moderate, or high risk depending upon the severity of the disease.

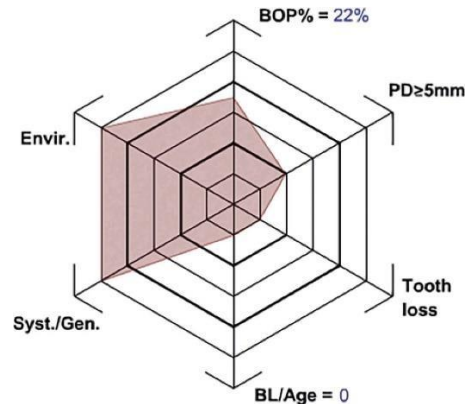


Fig :1 Periodontal risk assessment tool (PRA)<sup>7</sup>

The UniFe (Union of European Railway Industries)<sup>8</sup> method of risk assessment is based on five parameters which include smoking status, diabetes status, probing pocket depth >5mm, bone loss pertaining to the age of the patient, and the bleeding on probing score. All risk scores from the patient data will be assigned a score, and the sum of all scores will be used to determine the patient's risk level. Patients can be categorized accordingly (Fig:2).



Fig:2 UniFe (Union of European Railway Industries) risk tool<sup>8</sup>

### Results:

The statistical analysis was performed using SPSS software version 20.0 IBM USA, in which the individual parameters in the study were evaluated with descriptive statistics representing their mean values and standard deviations respectively. Normality was performed using the Kolomogrov Smirnof test after which parametric and non-parametric test was performed for inferential statistics. The comparison between the groups was done by ANOVA test or Kruskal wallis Test and correlation of factors was performed using Pearson correlation coefficient test or Spearman correlation coefficient test with a p-value less than or equal to 0.05 as a statistically significant difference was kept to find the correlation between periodontal disease risk and metabolic syndrome. A total of 60 individuals were included for the study, among them 36 were male and 24 were female. Fig 3 represents the distribution of risk for periodontal disease among the individuals included in the study in which PRA showed 35 percent moderate/medium risk, 25 percentage high risk, and 40 percent low risk. Likewise, in UniFe assessment, it showed 25 percent patients in moderate risk, 33.3 percent in high risk and 41.7 percent in low risk.

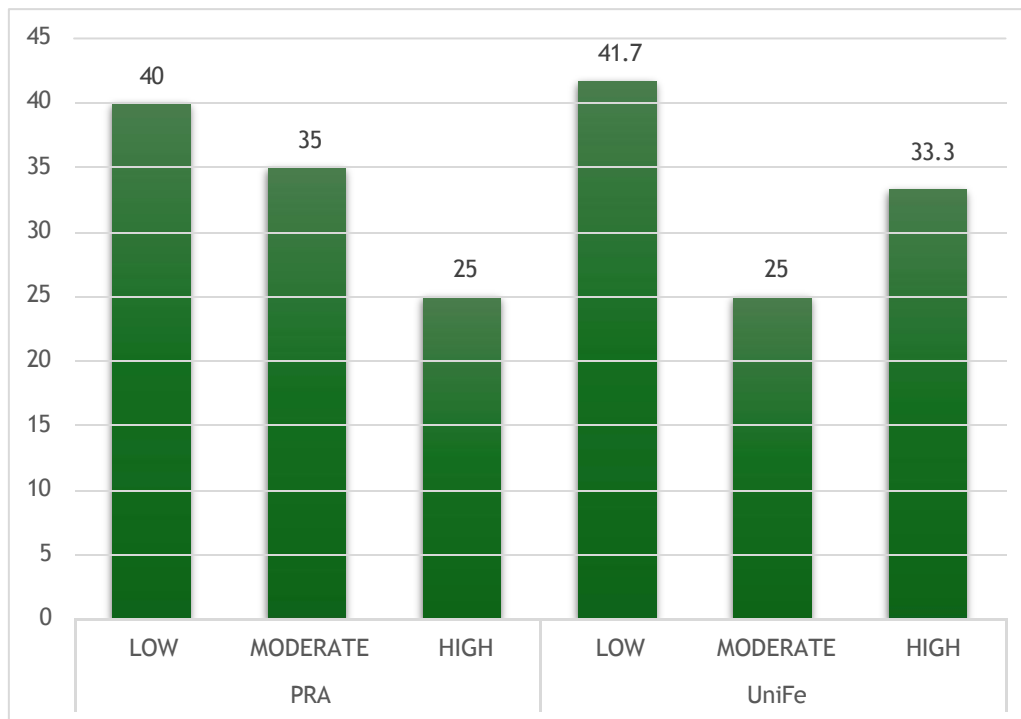


Fig :3 Distribution of risk of periodontal disease in PRA and UniFe among the study population

ANOVA test was done to find the comparison between the factors in metabolic syndrome (waist circumference, blood pressure, fasting blood glucose triglycerides, and HDL) with PRA and UniFe respectively. Tables 3 and 4 showed that all the factors with PRA and UniFe represented high statistically significant differences in P value. The risk parameters (low, high, and moderate) had a good variation among the factors responsible for metabolic syndrome hence both the risk assessment tools showed statistical significance among the study population.

Parameter	Risk assessment	Mean	SD	Mean square	Sig
Waist	Low	76.75	9.719	1483.879	.000
	Moderate	87.57	13.934		
	High	93.93	10.879		
BP	Low	1.38	1.013	26.403	.000
	Moderate	2.95	1.431		
	High	3.60	1.056		
FG	Low	86.21	12.635	3611.627	.000
	Moderate	105.81	19.811		
	High	111.47	12.328		
TR	Low	145.58	25.238	25939.479	.000
	Moderate	197.76	64.637		
	High	213.53	57.026		
HDL	Low	60.71	9.498	3002.411	.000
	Moderate	41.29	8.770		
	High	39.07	7.353		

Table 3: Comparison between the metabolic syndrome factors in relation to risk assessment determined by PRA among the study population.

Parameter	Risk assessment	Mean	SD	Mean square	Sig
Waist	Low	76.16	9.961	1935.145	.000
	Moderate	86.07	13.166		
	High	94.75	10.264		
BP	Low	1.36	.995	28.112	.000
	Moderate	3.00	1.464		
	High	3.50	1.100		
FG	Low	86.00	12.359	3996.750	.000
	Moderate	105.47	18.689		
	High	111.55	15.084		
TR	Low	145.24	24.806	29013.620	.000
	Moderate	194.33	59.140		
	High	215.20	62.347		
HDL	Low	59.88	9.404	2776.238	.000
	Moderate	40.67	8.981		
	High	40.15	9.092		

Table 4: Comparison between the metabolic syndrome factors to risk assessment determined by UniFe among the study population.

Table 5 represents the correlation between the factors responsible for metabolic syndrome towards the risk assessment method PRA and UniFe in which the PRA method showed a positive correlation of 52 percent variation towards the risk assessment. Blood pressure showed a 61.3 percentage variation, fasting glucose showed 56.1 percent, and Triglycerides showed a 49.2 percent variation but in the HDL group, it showed a negative correlation of 69.5 percent variation in the risk assessment relation to metabolic syndrome. Likewise, in the UniFe group, there was a high statistical significant difference among all the parameters in which a 60.2 percentage correlation was seen with waist circumference 62.9 percentage correlation was seen in blood pressure 59.9 percent was seen in fasting glucose, 53.4 percent in triglycerides and of 66.4 percentage in HDL group in the risk assessment towards periodontitis among the metabolic syndrome factors in the

study population. Table 6 represents the correlation between the risk assessment methods, PRA and UniFe in determining the periodontitis among metabolic syndrome factors in which both the group showed a very good statistical significant difference with 81.2 percentage correlation existing between them in assisting the risk for periodontitis.

Parameter	Correlation	Waist circumference	BP	FG	TR	HDL
PRA	Pearson value	.521**	.613**	.561**	.492**	-.695**
	Significance	.000	.000	.000	.000	.000
UniFe	Pearson value	.602**	.629**	.599**	.534**	-.664**
	Significance	.000	.000	.000	.000	.000

Table 5: Correlation between the factors and PRA and UniFe risk assessment methods

Parameter	Correlation	Unife
PRA	Pearson value	.812**
	Significance	.000

Table 6: Correlation between the risk assessment methods PRA and UniFe

### Discussion:

Periodontal disease is a chronic inflammatory disease involving the tooth-supporting structures, The pathogenesis of periodontal disease involves the increase in the inflammatory burden by complex enzymatic and nonenzymatic mechanisms and degradative mechanisms<sup>9</sup>. Periodontal disease is found to have a bidirectional relationship with many systemic illnesses<sup>10</sup>. Periodontal disease infection is found to be a potential risk factor for cardiovascular disease, diabetes, and rheumatoid arthritis since they increase the morbidity and mortality of these diseases. The bidirectional relationship also proves the impact of systemic illnesses on the periodontium. This may be attributed to the metastatic spread of infection, injury to the periodontium because of circulating microbial toxins, metastatic inflammation, etc.



Metabolic syndrome comprises of a cluster of factors that increase the risk of cardiovascular diseases and type 2 diabetes mellitus. However, a strong relationship was also found between periodontal disease and metabolic syndrome. In a study done by Iwasaki et al in 2015<sup>11</sup>, they concluded that patients with metabolic syndrome are 2.6 times more likely to get periodontitis, however, no studies have found the risk for the disease using simple blood investigation and assessment tools. Hence this study aims to find the correlation between all the factors of metabolic syndrome to risk of periodontal disease using two different assessment tools.

Obesity can be defined as the excessive accumulation of fat that leads to potential health risks. The adipocytes that are stored are found to release a large number of proinflammatory cytokines namely adipokines<sup>12</sup> which are found to increase the systemic inflammatory burden creating a risk for periodontitis or may be due to oxidative stress or alteration in oral microbiome. Gorman et al in the year 2012<sup>13</sup> conducted a study where he established the association between obesity and periodontal disease. Many studies also found an association between obesity and periodontitis<sup>14,15</sup>. The visceral fat is found to be more metabolically active than subcutaneous fat hence contributing to metabolic abnormalities and resulting in inflammation<sup>16</sup>. Thus, waist circumference is taken into consideration rather than BMI. In our study a strong association has been found between waist circumference and both the risk assessment tools PRA and UniFe with P value (<0.05).

Hyperlipidemia is characterized by an increase in triglyceride levels >150 mg/dl and HDL cholesterol levels <40mg/dl. Periodontal disease and hyperlipidemia have common risk factors such as lipopolysaccharide-related responses, increased response by monocytes, and stress<sup>6</sup>. In a study done by Thapa et al in 2016<sup>17</sup>, a strong association was found between high levels of serum cholesterol and periodontitis similarly in our study a strong association has been found between triglyceride levels(49.3 % -PRA,53.4%-UniFe) and HDL(69.5 % -PRA,66.4%-UniFe) levels individually with the risk assessment tools PRA and UniFe.

Insulin resistance is the reduction in insulin and the responsiveness of tissues to insulin resulting in the increase in blood glucose level. Insulin resistance is a condition that predisposes to type 2 diabetes mellitus which may be attributed to inflammation or alteration in insulin secretion by periodontal microbiota. An association has been found between insulin resistance and periodontitis by Benguigui, C et al in 2010<sup>18</sup>. In this study a strong association has been found between insulin

resistance (fasting blood glucose > 100mg/dl) and the risk of periodontal disease in both PRA and UniFe (P value < 0.05).

Hypertension the most common cardiovascular disease is diagnosed as those with systolic blood pressure >140mmhg and diastolic pressure >90mmhg. Many studies have found the association between periodontal disease and hypertension owing to the inflammatory burden caused by both the diseases, or severe endothelial inflammation by the microbiome<sup>19,20</sup>. Xavier et al 2019<sup>19</sup> in a study found that hypertension is directly related to the severity of periodontal disease. Similarly in our study patients in pre-hypertensive state and those with hypertension fall under moderate and high-risk categories in both PRA (61.3 % Variation) and UniFe(62.9%).

Risk assessment tools are simplified ways of finding an individual's risk of a particular disease. Periodontal disease being a multifactorial disease has many causative factors hence concluding a diagnosis takes a much longer time. This online risk assessment tool makes it easier to find the risk for periodontal disease in easier and simpler ways. In our study, both the assessment tools PRA and the manual tool UniFe showed good agreement proving the influence of metabolic syndrome on periodontal disease proving metabolic syndrome to be a potential risk for periodontitis. The level of agreement between the two tools (Pearson value -0.812, p-value <0.05). also proves the accuracy of both tools in diagnosing the risk for periodontal disease.

### **Conclusion:**

To conclude the factors involved in the metabolic syndrome individually possess a high risk for periodontal disease, hence lifestyle modifications and oral hygiene practices are much needed to prevent both the diseases since they have a bidirectional relationship. Risk assessment tools are simple ways to diagnose the risk for a specific disease without much burden.

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