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Periodontal Inflammatory Surface Area (PISA) – A Measure Of Inflammatory Burden In Periodontitis Condition In Obese Individuals

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Abstract
Background: *Overweight and obesity are rapidly increasing in countries like India. The prevalence of overweight increased from 9.7 % before 2001 to 13.9 % in studies reported after 2010. Obesity contributes to an overall inflammatory condition through its metabolic and immune parameters, thereby increasing susceptibility to periodontal disease. Periodontal disease is one of the most common chronic inflammatory condition. The rising prevalence of obesity has resulted in an increased burden from several major diseases, notably diabetes with recent evidence suggesting a possible link to periodontitis. The inflammation can be best measured using Periodontal Inflammatory Surface Area score (PISA). There is growing evidence that "Infectobesity"– a condition of obesity arising due to infection could be a key factor predisposing to obesity albeit diet and lifestyle causes.*
Objective: *The present study aims to highlight the effect of periodontitis and inflammatory score on the extent of obesity.*
Methodology: *Individuals reporting to department of Periodontics, SBDCH who were obese/overweight were recruited for the study. A questionnaire-based survey was conducted to evaluate diet, lifestyle, stress and body mass index and waist-hip ratio. Periodontal parameters namely, bleeding on probing, recession and clinical attachment were measured to calculate Attachment level surface Area (ALSA) and Recession surface area (RSA), from which Periodontal Epithelial Surface Area (PESA) and Periodontal Inflammatory Surface Area (PISA) were deduced by software analytic tools.*
Analysis: *To understand the correlation and gain insight between periodontal parameters, PESA/PISA and obesity levels.*
Results: *Spearman's correlation was done. Since the p value is greater than 0.05, we can conclude that there is no significant relationship between BMI, BOP, Age, waist measurement and PISA score.*
Conclusion: *Results showed there is no significant relation between PISA with obesity status for the sample population. Increased value of BOP correlates with increased PISA score.*
Keywords: *Obesity, Infectobesity, PISA, Periodontitis.*

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I. Background:

Obesity is a highly prevalent condition worldwide especially in developed countries (WHO 2006). It is a metabolic condition occurring due to an energy imbalance (intake > consumption) , BMI > 30.0 kg/m2, which subsequently leads to an increase in adipose tissue deposits (Bray 2007). One of the most common chronic diseases is periodontal disease. Periodontitis is associated with inflammation of periodontal apparatus, leading to destruction of connective attachment and loss of teeth. Obesity is one of the systemic conditions which influences the onset and progression of periodontal disease. Obesity may be associated with the acquisition and persistence of specific bacteria in the oral flora. Studies have described an association between either obesity, increased body

weight or increased body mass index (BMI) and periodontal diseases in humans. Periodontitis has been proposed to have a contributory role to systemic conditions such as cardiovascular disease primarily through the inflammatory and microbial burden posed by the inflamed surface area of the periodontal pocket. Nesse *et al*., 2008, developed a quantifiable system for determining burden posed by chronic periodontitis and is termed as "Periodontal inflammatory surface area (PISA)."

The objectives of this study were to estimate the effect of periodontitis and inflammatory score on the extent of obesity and to estimate the inflammatory burden posed by chronic periodontitis by calculating the periodontal inflammatory surface area.

II. Methodology:

Individuals reporting to department of Periodontics, SBDCH who were obese/overweight were recruited for the study.

Study Population: A total of 21 individuals were selected.

Exclusion Criteria: Participants who were pregnant and lactating mothers, any antibiotic or steroid therapy for the past 6 weeks, periodontal treatment for past six months, individuals on anti-depressants, hormone imbalance individuals are excluded from the study.

Inclusion Criteria: Participants who were obese Obese/ Overweight individuals (BMI - > 25)both male/ female of age 25-60 years in presence of ≥20 scorable teeth.

Study Design:
Pilot Study

Individuals reporting to department of Periodontics, SBDCH who were obese/overweight, recruited for the study. A questionnaire-based survey was conducted to evaluate diet, lifestyle, stress. Height and weight of the person is measured to calculate Body mass index of > 30.0 kg/m^2, and waist-hip ratio using measuring tape were recorded. Periodontal parameters namely, bleeding on probing, clinical attachment level, recession , pocket probing depth were measured using Williams probe. Periodontal epithelial surface area(PESA) & Periodontal Inflammatory Surface Area(PISA) was deduced by software analytic tools www.parsprototo.info

Periodontal inflamed surface area was calculated in 4 ways:

1. After filling PPD measurements at six sites per tooth, the computer calculates the mean PPD for each tooth.
2. The mean PPD around a tooth is entered into a formula that translates this linear mean PPD into a periodontal epithelial surface area (PESA) for that specific toot. The PESA for a tooth is the root surface area of that tooth (in mm^2), i.e.; covered by a pocket epithelium.
3. **PESA** value is calculated by subtracting recession surface area from attachment level surface area.
4. **PISA** value of individual tooth is calculated by multiplying PESA of each tooth with number of affected sites by BOP divided by maximum no. of sites.

Periodontal Inflammatory Surface Area (PISA) Of Individual Tooth

$$\textbf{PISA} = \frac{\textbf{PESA X no. of sites of affected by Bleeding on probing}}{\textbf{Maximum no. of sites}}$$

Total PISA score of an individual is calculated by summing up of all individual PISA score of teeth.

Statistical Analysis: Mean and standard deviation was assessed for continuous variables, and a multivariate logistic regression analysis was performed to assess the influence of risk elements on periodontitis prevalence. $P < 0.05$ was considered statistically significant

III. Results:

This study was done to determine the effect of periodontitis and inflammatory score on the extent of obesity. This study has a total of 21 samples conducted to evaluate diet, lifestyle, stress and body mass index and waist-hip ratio. Periodontal parameters namely, bleeding on probing, recession and clinical attachment were measured to calculate Attachment level surface Area (ALSA) and Recession surface area (RSA) , from which Periodontal Epithelial Surface Area(PESA) and Periodontal Inflammatory Surface Area(PISA) were deduced by software analytic tools. Since the total sample size is 21 which is less than the minimum sample size required for parametric tests, we performed the analysis using non-parametric methods.

Descriptives:
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std.Deviation
BMI	21	25.10	35.80	28.2762	3.32128
Age	21	24	57	40.57	8.829
Waist (inches)	21	32.00	48.00	40.2762	4.42288
PISA	21	8.944	1132.284	324.89476	268.046552

To determine the relationship between age and PISA score
Spearman's correlation was performed since the assumptions of Pearson correlation was violated.

CORRELATIONS				
			PISA	AGE
Spearmans rho	PISA	Correlation coefficient	1.000	.288
		Sig. (2 tailed)	.	.205
		N	21	21
	AGE	Correlation coefficient	.288	1.000
		Sig. (2 tailed)	.205	.
		N	21	21

Interpretation: Since the p value is greater than 0.05, we can conclude that there is no significant relationship between age and PISA score.

To determine the relationship between BMI and PISA score
Spearman correlation was performed since the assumptions of Pearson correlation was violated.

CORRELATIONS				
			BMI	PISA
Spearmans rho	BMI	Correlation coefficient	1.000	-.327
		Sig. (2 tailed)	.	.148
		N	21	21
	PISA	Correlation coefficient	-.327	1.000
		Sig. (2 tailed)	.148	.
		N	21	21

Interpretation: Since the p value is greater than 0.05, we can conclude that there is no significant relationship between BMI and PISA score.

To determine the relationship between waist measurement and PISA score
Spearman correlation was performed since the assumptions of Pearson correlation was violated.

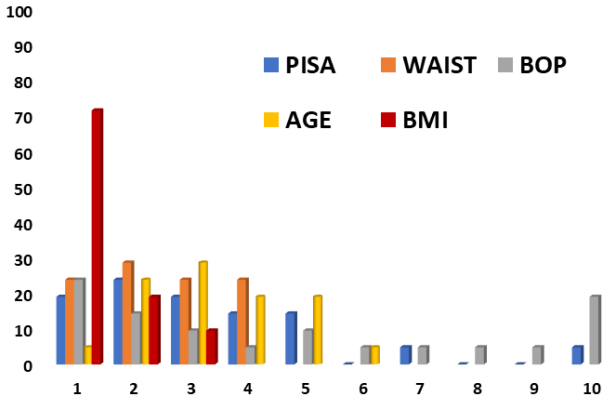
CORRELATIONS				
			PISA	WAIST
Spearmans rho	PISA	Correlation coefficient	1.000	.111
		Sig. (2 tailed)	.	.632
		N	21	21
	WAIST (inches)	Correlation coefficient	.111	1.000
		Sig. (2 tailed)	.632	.
		N	21	21

Interpretation: Since the p value is greater than 0.05, we can conclude that there is no significant relationship between waist measurement and PISA score.

To determine the relationship between BOP and PISA score
Spearman correlation was performed since the assumptions of Pearson correlation was violated.

CORRELATIONS				
			BOP	PISA
Spearmans rho	BOP	Correlation coefficient	1.000	.005
		Sig. (2 tailed)	.	.982
		N	21	21
	PISA	Correlation coefficient	.005	1.000
		Sig. (2 tailed)	.982	.
		N	21	21

Interpretation: Since the p value is greater than 0.05, we can conclude that there is no significant relationship between BOP and PISA score.



PISA SCORE: 8 TO 120 – 1,120 TO 232 - 2,232 TO 354 -3, 354 TO 466- 4,466 TO 578- 5, 578 TO 690 – 6,690 TO 802 – 7,802 TO 914 – 8, 914 TO 1026 – 9 ,1026 TO 1138 – 10, BOP: 15 TO 24-1, 24 TO 32-2, 32 TO 41-3, 41 TO 50-4, 50 TO 59-5, 59 TO 68 -6, 68 TO 77-7, 77 TO 86-8, 86 TO 95-9, 95 TO 104 WAIST: 32 TO 36 -1, 36 TO 40 -2, 40 TO 44-3, 44 TO 48-4
BMI: 25 TO 29.9 -1, 30 TO 34.9 -2, 35 TO 39.9 – 3
AGE: 24 TO 30 -1, 30 TO 36-2, 36 TO 42-3, 42 TO 48-4, 48 TO 54 -5, 54 TO 60-6

IV. Discussion:

Obesity is an out growing epidemic condition. obesity is considered as excessive fat accumulation that impair health & associated as major risk for chronic diseases. One of the most common chronic disease is periodontitis. there are many evidences that changes in microbiota in obese individuals would worsen the condition & can be named it as Infectobesity. i.e., condition of obesity arising due to chronic infection.

Pro-inflammatory cytokines may play a crucial role in the close relationship among periodontitis, obesity, and chronic diseases (Beck and Offenbacher, 2005; Genco *et al.*,2005). In fact, this association may be multidirectional and has been supported by systematic reviews

Obesity contributes to an overall inflammatory condition through its metabolic and immune parameters, thereby increasing susceptibility to periodontal disease.

As the association between obesity and periodontal disease is multidirectional and is already proven. A new entity called Periodontal inflammatory surface area is involve in the study which is a measures Periodontal inflammation.

PISA predicts the probability of periodontitis to cause or deteriorate other diseases by quantifying the inflammatory burden posted by periodontitis. One of the parameters which we have taken in this study is the PISA index developed by Nesse in the year 2oo6. This is the first report which has used the PISA system to assess inflammatory burden in obese condition.

Periodontal disease may contribute to the development of obesity and the role of the oral microbiota in obesity has been gaining more attention. Studies have shown that obesity is also associated with increased counts and proportions of certain periodontal pathogens, including *Tannerella forsythia* and *Selenomonas noxia*

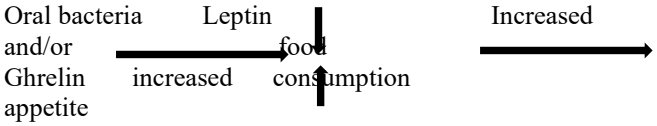
Recent studies have shown the association between levels & proportions of subgingival species in obese patients. Several findings indirectly support the hypothesis that oral bacteria is related to obesity. The most direct evidence is from animal studies(mice). In the gut microbiota promotes absorption of carbohydrates & leads to lipogenesis and increase fat storage. With this evidence Goodson et al in 2009 conducted a human study & explained the hypothesis how flora is related to obesity by 3 mechanisms. First the oral bacteria increases metabolic activity. Second the oral bacteria increases appetite. Third is that oral bacteria redirect energy metabolism. By any one of these mechanisms, even a small amount of increase in calorie consumption with no change in diet or exercise could result in weight gain. Hence, any study of infection – related weight gain should include measure of food consumption and exercise.

Hypothesis I : **Oral bacteria increase metabolic efficiency**

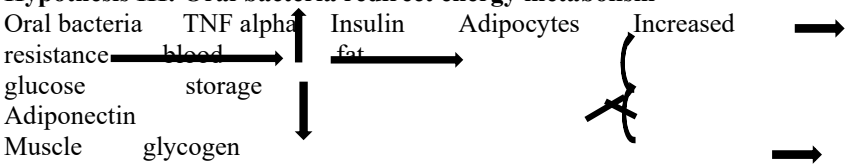
Oral bacteria
Food GI Tract → Increased fat →

increased storage
metabolic efficiency

Hypothesis II : Oral bacteria increase appetite



Hypothesis III: Oral bacteria redirect energy metabolism



Obesity contributes to an overall inflammatory condition through its metabolic and immune parameters, thereby increasing susceptibility to periodontal disease.

PISA predicts the probability of periodontitis to cause or deteriorate other diseases by quantifying the inflammatory burden posted by periodontitis. One of the best parameters taken in this study is PISA index developed by Nesse in 2006. This index quantifies the inflamed surface area present in the periodontal tissues and shows an indirect clinical measure of inflammatory burden in chronic periodontitis. This is the first report which has used the PISA system to assess inflammatory burden in obese condition. This study showed there is increase in PISA score along with increase in Bleeding on probing which is an initial sign of inflammation

V. Drawbacks:

The primary limitations of this study can be seen in its small sample size, which is not a representative population showed that there is significant relation between PISA score and obesity. Confounding factors like diabetes, smoking could not be eliminated.

VI. Conclusion:

As, we understood that microbiota dictates lifestyle in every individual and in that individual, chronic inflammatory condition would increase tendency to change metabolism & increase in development of obesity. So, it must be taken up as a longitudinal study & microbiological study for further evidence.

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