Evaluation of the Periodontal Parameters in Pregnant Women with Metabolic Syndrome: A Cross-Sectional Study

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ABSTRACT:

Introduction: With the adoption of modernized lifestyle, the prevalence of Metabolic syndrome (MeS) is increasing. Consequently, it becomes imperative to evaluate its association with other conditions such as periodontitis, especially in pregnant women.

Objectives: To evaluate the periodontal parameters of pregnant women with metabolic syndrome.

Methods: A total of 144 pregnant females aged 18-34 years with MeS participated in the study. Data was gathered through a comprehensive questionnaire that encompassed demographic characteristics like age, diet, medical history, and oral health behaviors. Subsequently, dental examinations were conducted to assess the Gingival Index, Plaque Index, Bleeding on probing, Probing depth (PD), and Clinical attachment loss (CAL). The patients were then classified into three categories: Mild, moderate, and severe periodontitis. Blood samples were also collected and analyzed for blood glucose, triglyceride, and HDL cholesterol levels. Additionally, the Systolic and Diastolic BP, pre-gestation waist circumference, and BMI were recorded to diagnose MeS. The relationship between number of MeS components and severity of periodontal disease was evaluated using chi-square test. For every test, a P value of less than 0.05 was deemed statistically significant (P <0.05).

Results: Majority of participants (33.3%) exhibited gingivitis, while 20.8% had severe periodontitis. However, no statistically significant association was observed between the level of periodontal conditions and positive factors for MeS (p>0.05).

Conclusions: It was found that all patients with MeS had some form of periodontal disease, with the highest proportion of participants presenting with gingivitis. The association between the severity of periodontal disease and the elevated presence of MeS components, especially in the setting of pregnancy, is still up for dispute, though.

1. Introduction

Periodontitis is a long-term infectious condition affecting the tissues supporting teeth. It is influenced by various factors.[1] Its distinguishing features are dysbiotic plaque biofilms and a gradual deterioration of the tooth-supporting structure.[2] As mentioned by World Health Organization, primary reason of loss of teeth among adults is periodontitis.[3] A multitude of systemic illnesses, including metabolic syndrome, diabetes mellitus, and cardiovascular disease, have been linked to periodontitis.[4-7] To improve diagnostic techniques and treatment outcomes, there has been a recent surge in interest in investigating the connection between systemic diseases and periodontal disease.[1]

Systemic conditions like obesity, dyslipidemia, poor glucose regulation, and hypertension are all part of metabolic syndrome. It is also seen that heightened danger of cardiovascular disease and type 2 diabetes are

invariably associated with this condition.[8] It is believed that as many as 25% of adults worldwide suffer from metabolic syndrome.[1] Most people agree that the root cause of this illness is a pro-inflammatory state brought on by excessive caloric consumption, malnutrition, and other chronic inflammatory illnesses. It is known that poor metabolic control and consequences of diabetes mellitustype 2 are linked with periodontal disease.[1] It has also been linked to an increased risk of cardiovascular disease in cross-sectional studies. Research has looked into potential connections and interactions amid metabolic syndrome and the periodontal disease.

One potential unifying mechanism that could explain the connection between each element of the metabolic syndrome and periodontitis is oxidative stress.[9] Notably, despite the consequences of age and many other risk factors, women seem to be more impacted than men by the components metabolic syndrome. The initiation and the development of metabolic syndrome for the duration of pregnancy pose major threat both forthe mother and health of the unborn child.[10] Increases in progesterone, estrogen, and other placenta-derived hormones during pregnancy cause alterations in the levels of inflammatory mediators and immunosuppressants.[11] During pregnancy, high amounts of estrogen and progesterone can cause changes to the mouth and lower immunity. As a result, throughout this time, tooth biofilm production may occur and the patient's periodontal status may deteriorate.[12] Furthermore, systemic alterations during pregnancy are associated with arterial hypertension, weight gain by the mother, pregnancy-induced diabetesandanemia.[13]

A higher risk of both poor periodontal state and metabolic syndrome has been shown in previous research,[1] as well as a higher risk of both conditions in those with poor periodontal status. Additionally, studies have connected periodontitis to obesity and gestational diabetes in expectant mothers.[10,11]

Our literature search revealed, however, that there is a dearth of assessment of periodontal markers in pregnancy of the women with metabolic syndrome.[14]

2. Objectives

Considering that metabolic syndrome is more common among Asians and that it is becoming more common as a result of modern lifestyle. Hence, the objective of

present study was to evaluate the periodontal parameters of pregnant women with metabolic syndrome.

3. Methods

This study comprised 150 pregnant women in total. Patients were recruited from maternity hospitals of Riyadh City during period of March 2018 to January 2020. Sample size estimation was done using formula $n=Z^2P(1-P)/d^2$. The formula denotes the following: n here represents sample size; Z denotes confidence level (1.96); expected prevalence denoted by P (11%) derived from a prior study by Piscoya MD et al., 2012;[15] and d is the precision (effect size = 0.05). Six individuals, however, dropped out of the study, leaving 144 people in total as the sample size. The Institutional Review Board of the Research and Innovation centre of Riyadh Elm University granted ethical approval prior to the commencement of the study (Registration No # FRP/2018/61).

Contrarily, patients with a history of abortion, those who had assisted reproductive treatments like hormone replacement therapy or medication, those who had undergone genitourinary infections or HIV within the previous six months, those with medical conditions that would prevent them from having periodontal probing, those who had undergone periodontal treatment or had used mouthwashes like chlorhexidine, those who had rampant decay, those who had taken anti-inflammatory drugs or antibiotics or within six months prior to the study, those who had used cyclosporine, hormone replacement therapy and/or, phenytoin, and those who were tobacco user especially smoking kind, alcoholics, or ex-smokers,or ex-smokers, as well as individuals who had been diagnosed with any other acute or chronic infection during the preceding six months based on a clinical examination or standard laboratory testing, were not allowed to participate in study.

The patients were given a thorough explanation of the trial before obtaining their written informed permission. The patients were assessed using a thorough questionnaire that captured information on their age, nutrition, medical history, and dental hygiene practices. During each visit, the lead investigator conducted interviews with all participants to learn more about their knowledge, practices, and any risk factors causing unfavorable outcomes during pregnancy related to dental

hygiene. In order to record the patients' past pregnancies, the status of their current pregnancies, and any unfavorable outcomes, the primary investigator also went over the medical data.

After doing every dental examination, the principal investigator recorded the following data: the total teeth present, filled and carious teeth, Gingival and the Index, quantity of bleeding during and after probing, the depth of probing (PD), and the clinical loss of attachment (CAL).

Following a thorough periodontal assessment, the following evaluations were made:

Four sites were used to evaluate plaque and gingival index for each tooth in the dentition, while six sites were used to evaluate the attachment levelobserved clinically, probing depth and bleeding during probing. After a revision of Loe and Silness, 1964 GI,[16] the Gingival Index (GI) was employed to estimate gingival inflammation in all teeth, with the exception of third molars. The following scores are used by the GI: Gingiva can be classified as normal (0), mildly inflamed (1), moderately inflamed (2), or severely inflamed (3).

Using a zero–three scale, the Plaque Index (PI) provided pre-brushing plaque scores for each tooth's buccal surface.

A PI of "0" indicates that there is no plaque on the clinical crown, while a PI of "3" indicates that soft deposits are present and cover more than two-thirds of the crown.

Bleeding on Probing (BOP). Following the completion of probing procedures for each quadrant, BOP was measured and recorded. The following was the scoring breakdown:

0 = absence of bleeding; 1 = bleeding present.

The University of North Carolina -15 probe (UNC 15), a manual periodontal probe made by Hu-Friedy in Chicago, Illinois, was used to measure gingival recession and probing depth. With the use of this probe, information about every tooth in the oral cavity was collected.We employed the periodontitis case definition provided by Case definition of Periodontitis outlined by American association of periodontics.[17]

Chronic periodontitis may be further subclassified into localized and generalized forms and characterized as mild, moderate, or severe based on the following specific features:

• Localized form: <30% of teeth involved

• Generalized form: >30% of teeth involved

• Mild: 1 to 2 mm clinical attachment loss (CAL)

• Moderate: 3 to 4 mm CAL

• Severe: ≥5 mm CAL

According to Dos Prazeres Tavares et al. (2016),[18] an individual would meets the criteria for Metabolic Syndrome (MeS) as defined by the Adult Treatment Panel (ATP) III if they displayed three (3) or more of subsequent elements:[18] high blood pressure (both systolic and diastolic exceeding 130/85 mm Hg, or under the treatment for hypertension), hypertriglyceridemia (serum triglyceride surpassing 150 mg/dl), abridged high-density lipoprotein (HDL) cholesterol (serum cholesterol HDL below 50 mg/dl among women), and obesity at the abdomen (waist circumference greater than that of 88 cm among women preceding conception), pregestational body mass index (BMI) surpassing 30 kg/m^2, high fasting glucose (serum glucose level exceeding 110 mg/dl or being treated for diabetes), and hypotriglyceridemia.

Blood samples and clinical data were gathered between weeks 20 and 21 of pregnancy. Blood samples were taken overnight, following at least ten hours of fasting. In the same medical laboratory, using standard laboratory procedures, HDL cholesterol, triglycerides and the blood levels of glucose, were measured for each sample that was collected.

Descriptive statistics, such percentages and frequency distributions, were calculated for categorical variables. The matching values of the mean and the standard deviation were found for continuous variables. Quantity of MeS components and the individuals' degree of periodontal disease were correlated, and the study used the Chi-square test to evaluate this relationship. A value of $p<0.05$ was considered significant statistically for each test that was conducted. All the analyses of the biostatistics were conducted using the IBM-SPSS statistical analysis program (version 25, Armonk, NY: USA).

4. Results

From the total of 144 females participated in study out of which 54.2% were from Saudi nationality and 41.7% were educational qualification of college and above (Table 1).

Table 1: Characteristics of the study participants (N=144)

Characteristics		n	%
Nationality	Saudi	78	54.2
	Non-Saudi	66	45.8
Education	Did not go to school	26	18.1
	Only school	58	40.3
	College and Above	60	41.7
Employment	Unemployed	96	66.7
	Employed	42	29.2
	Student	6	4.2
	Others	0	0.0
Income	<2000	77	53.5
	2000-5000	34	23.6
	5001-10000	9	6.3
	10001-15000	18	12.5
	>15000	6	4.2
Medical insurance	Yes	96	66.7
	No	48	33.3
Dental insurance	Yes	73	50.7
	No	71	49.3

Few of the participants reported very good health (18.1%) and around 49.7% reported as having anemia (Table 2).

Table 2: General health condition of the study subjects

Items		n	%
Self-reported general health	Very good	26	18.1
	Good	32	22.2
	Fair	41	28.5
	Poor	39	27.1
	Dont know	6	4.2
Hypertension	Yes	144	100.0
	No	0	0.0
Diabetes	Yes	144	100.0
	No	0	0.0
Anaemia	Yes	69	47.9
	No	75	52.1
Respiratory disease	Yes	0	0.0
	No	144	100.0
Kidney disease	Yes	0	0.0
	No	144	100.0
Liver disease	Yes	0	0.0
	No	144	100.0
Epilepsy	Yes	0	0.0
	No	144	100.0
Heart disease	Yes	0	0.0
	No	144	100.0
Veneral disease	Yes	0	0.0
	No	144	100.0
Genito-urinary disease	Yes	0	0.0
	No	144	100.0
AIDS	Yes	0	0.0
	No	144	100.0
Med.Last 6Mos	No	144	100.0
	Yes	0	0.0

A total of 43.8% reported brushing twice daily and flossing once per day each, and 22.2% reported regular dental visit every 6 months (Table 3).

Table 3: Oral health behavior and dental visit of the study participants

Oral health behavior		n	%
Brushing Teeth	Twice a day	63	43.8
	Once a day	47	32.6
	Irregular	24	16.7
	Do not brush	10	6.9
Flossing	Once per day	63	43.8
	Irregular	47	32.6
	Dont floss	34	23.6
Visit to dentist	Pain	25	17.4
	Regular every 6 months	32	22.2
	Irregular	59	41.0
	I dont know	28	19.4

Similarly, 40.3% reported regular exercise weekly, 17.4% reported having fruits and 21.5% having vegetables daily and 31.3% were taking supplements daily (Table 4). The average gestational age was 20.67 weeks and BMI was 31.74 and serum HDL cholesterol, triglycerides and glucose levels were 48.23, 160.53 and 127.88, respectively in study participants.

(Figure1).Similarly, mean scores of Gingival Index, Periodontal Index and Bleeding on probing wre 1.46, 1.67 and 0.78, respectively in selected pregnant females.

Table 4: Exercise and dietary habits

Habits		n	%
Regular weekly exercise	Regular	58	40.3
	Irregular	55	38.2
	Do not excercise	31	21.5
Fruits	Do not eat	7	4.9
	2-3 times/mos	13	9.0
	2-3/week	99	68.8
	Daily	25	17.4
Vegetables	Do not eat	0	0.0
	2-3 times/mos	19	13.2
	2-3/week	94	65.3
	Daily	31	21.5
Dairy products (Milk, yogurts, butter and cheese)	Do not eat	0	0.0
	2-3 times/mos	19	13.2
	2-3/week	94	65.3
	Daily	31	21.5
BCR (Bread, Cereals, Rice and Pasta)	Do not eat	0	0.0
	2-3 times/mos	16	11.1
	2-3/week	97	67.4
	Daily	31	21.5
MPFE (Meat, Poultry, Fish and Eggs)	Do not eat	0	0.0
	2-3 times/mos	18	12.5
	2-3/week	103	71.5
	Daily	23	16.0
Bevrge (Tea, coffee, fizzy drinks and fruit juices)	Do not eat	0	0.0
	2-3 times/mos	19	13.2
	2-3/week	94	65.3
	Daily	31	21.5
Snacks (Candy, cakes, fast food, nuts and desserts)	Do not eat	0	0.0
	2-3 times/mos	19	13.2
	2-3/week	95	66.0
	Daily	30	20.8
Supplements (Multi-vitamins and minerals)	Do not eat	26	18.1
	2-3 times/mos	32	22.2
	2-3/week	41	28.5
	Daily	45	31.3

The presence of 3,4 and 5 positive factors of MeS were seen in 44.4%, 35.4% and 20.1 % females, respectively. Similarly, gingivitis and mild, moderate and severe periodontitis were seen in 33.3%, 18.1%, 27.8% and 20.8%, respectively. (Table 5)
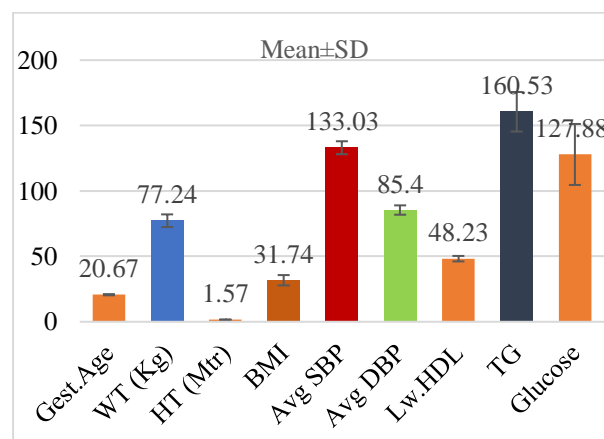

Figure 1: Gestational age and MeS components (Gest=Gestational, WT=weight in Kilograms, HT=Height in Meters, BMI=Body Mass Index, Avg=Average, SBP=Systolic Blood Pressure, DBP=Diastolic Blood Pressure, Lw=Low, HDL=High Density Lipoprotein, TG=Triglycerides, SD=Standard Deviation)

Table 5 : Distribution of the number of MeS components and Periodontal diagnosis

Variables		n	%
METS	3 positive factors	64	44.4
	4 positive factors	51	35.4
	5 positive factors	29	20.1
	Total	144	100
Periodontal severity	Gingivitis	48	33.3
	Mild periodontitis	26	18.1
	Moderate Periodontitis	40	27.8
	Severe Periodontitis	30	20.8
	Total	144	100

Among the patients who had 5 positive factors of MeS maximum had Gingivitis and moderate periodontitis (n=9; 31% each). And in females who had 4 positive factors of MeS maximum had gingivitis (n=22; 43.1%) followed by moderate periodontitis (n=12; 23.5%) and in participants who showed 3 positive factors of MeS maximum had moderate and severe periodontitis (n=19; 29.7% each). Thus, no statistically significant association was seen in between level of periodontal conditions and positive factors for MeS (p>0.05) (Table 6)

Table 6: Association between the number of MeS components and Periodontal severity

Periodontal Severity	3 Positive factors		4 positive factors		5 positive factors		χ^2	p
	n	%	n	%	n	%		
Gingivitis	17	26.6	22	43.1	9	31.0	9.54	0.145
Mild P	9	14.1	9	17.6	8	27.6		
Moderate P	19	29.7	12	23.5	9	31.0		
Severe P	19	29.7	8	15.7	3	10.3		

P=Periodontitis, χ^2 =Chi-square test.

5. Discussion

Lorem The different MeS components were noted and categorized in the current investigation. Previous studies have demonstrated the frequency of MeS in expectant mothers, with varying degrees of success. The reason for this diversity may be found in the diverse definition criteria used in the various studies.[10,19]

Gingivitis was the most common periodontal abnormality among the patients. Similarly, numerous studies have shown that gingivitis is more common in pregnant women than periodontitis.[20] The reported incidence of gingivitis in expectant mothers varies, however earlier studies have consistently demonstrated that gingival inflammation is very common. This variance might arise from the populations being studied and the varied definitions of gingivitis that have been utilized in different studies.[20] In pregnant women visiting a referral dental service, gingival bleeding was shown to be prevalent in 84.4% of cases, according to a cross-sectional study.[21] However, because particular case definition used, our results show a lower prevalence of gingivitis (21.67%). Since there is no cut-off criterion to differentiate between various degrees of severity of inflamed gingival sites, it is important to remember that the existence of a gingival inflammatory state (also known as a "gingivitis site") does not always imply the presence of gingivitis itself.[20]

Results of the present investigation proved that moderate periodontitis was most prevalent type, with mild and severe cases coming next. On the other hand, taking into account the severity of the disease, a prior study also revealed that most participants had moderate periodontitis.[20, 22]

The connections between periodontal disease and particular biochemical components, like cholesterol and glucose statistics during pregnancy times, as well as the linkages between metabolic syndrome and biochemical measures were shown by Bullon P et al.'s work.[23] In a recent meta-analysis, it was determined that there is a higher likelihood of encountering both Metabolic Syndrome (MeS) and Periodontal Diseases when MeS is present as the primary condition, rather than Periodontal Diseases preceding MeS, particularly among females.[24] Given the well-established associations between MetS and chronic diseases in adults, as well as the connections between pregnancy complications such as preeclampsia and gestational diabetes and the subsequent development of type 2 diabetes mellitus (T2DM) and cardiovascular diseases (CVDs), the period of pregnancy presents an opportunity to identify women with MeS. Further research has identified two distinct types of connections between inflammation of the periodontium and MeS. The first type involves the exacerbation of periodontal inflammation in the presence of MeS, while the second type pertains to the increased likelihood of developing MeS in individuals with periodontitis. This points, to a mutually reinforcing interaction between the two conditions, potentially explained by a cause-and-effect relationship highlighted by the persistent low-grade inflammation that characterizes both MeS and the aforementioned pathologies. Inflammatory markers such as tumor necrosis factor, interleukin (IL)-1, IL-6, and PAI-1 have been identified as factors associated with MeS that may exacerbate periodontal disease by promoting systemic inflammation, insulin resistance, and endothelial dysfunction.[25,26]

We did not detect a correlation between the existence of many positive MeS characteristics and the severity of periodontitis, despite the fact that all of the study participants had some kind of periodontal disease, which is consistent with previous findings about the relationship between MeS and periodontal illnesses. This

lack of association could be attributed to the complex pathophysiology of periodontitis, which considers several host, microbial, and environmental factors that impact the disease's course.[4] Furthermore, it is critical to understand the chronicity of the periodontal disease which, in the absence of any medication, often worsens with the advancing age and progress at a variable rate.[20]

Limitations- The absence of a standardized definition of MeS for pregnant women and the utilization of the definition considered in this research may lead to an overestimation of its prevalence. Additionally, certain findings may be susceptible to measure bias due to self-reported information that can potentially be influenced by recall bias. The study's design does not allow for the identification of a causal relationship between periodontal diseases and MeS. Multiple logistic regression and multivariate analysis, which could have aided in determining the correlation among the various variables in the study, were not conducted. Other confounding variables, such as snacking habits, lack of physical activity, genetic factors, and hereditary influences, were not included in the study. As the study focused on individuals with more than "20" teeth, the relationship between periodontal disease and MeS among those with less than "20" teeth and those who are edentulous remains unknown. In the future, a study should be conducted that takes into consideration the aforementioned aspects.

All patients diagnosed with Metabolic Syndrome (MeS) exhibited some form of periodontal disease, with the majority of participants presenting with gingivitis. There is ongoing discussion regarding the relationship between the severity of periodontal disease and the presence of different MeS components during pregnancy. Periodontal therapy, when integrated with other medical interventions, can contribute to a reduction in the occurrence of premature delivery. Early periodontal disease treatment could be a key component of the MeS treatment plan once a conclusive association has been shown.Moreover, oral health practitioners may recommend high-risk individuals for a MeS examination.

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