Impact of maternal periodontal health on fetus weight in Iraqi pregnant women: a clinical study

Impacto da saúde periodontal materna no peso fetal em gestantes iraquianas: um estudo clínico

Ali Raad ABDULAZEEZ[1] (iD), **Ali Bahaa KADHUM**[2] (iD), **Bimaa Hameed ALI**[2] (iD)

1 - University of Mashreq. Baghdad, Iraq.
2 - Iraqi Dental Association. Baghdad, Iraq.

ABSTRACT

Objective: the aim of this study was to investigate the relationship between periodontal health condition and the weight of fetuses in Iraqi pregnant women in order to magnify the importance of periodontal health maintenance during pregnancy. **Material and Methods:** fetus weight was determined using ultrasound scanning for 222 pregnant women, accordingly they were divided into two groups: group A: normal fetus weight and group B: below normal fetal weight. Their periodontal condition was examined by means of Plaque index (PI), Gingival index (GI), Bleeding on probing (BOP) and Clinical Attachment loss (CAL) using WHO CPITN periodontal probe. WHO charts of normal fetal weight for each week were considered to determine the normality of fetus weight. **Results:** significant value p=0.00 was obtained when comparing the examined periodontal parameters between groups A and B, mean of periodontal parameters of PI, GI and BOP were higher in group B (1.1964: 1.4541), (1.1877: 1.4925), (0.3553: 1.3748) respectively. Q2 and IQR of PI, BOP and GI in group A were (1.190:0.3), (0.30:0.5), (1.160:0.3) respectively. And (1.460:0.24) (1.50:0.7) (1.460:0.26) in Group B. There were 4 cases of CAL in group A as opposed to 88 cases in group B, Q2 of CAL in group A=0.00, Q2 in group B=1.00. IQR=0.00 in both groups. Non-significant value p=0. 503(p>0.05) was seen when comparing the incidence of low fetal weight between the three trimesters. **Conclusion:** it is important to maintain a good periodontal condition and oral Hygiene status in pregnant women for healthier fetal weight and healthier pregnancy with less complications.

KEYWORDS

Oral hygiene; Risk factors; Pregnancy; Fetal weight; Periodontal disease.

RESUMO

Objetivo: o objetivo deste estudo foi investigar a relação entre a condição de saúde periodontal e a peso dos fetos em gestantes iraquianas para ampliar a importância da manutenção da saúde periodontal durante a gravidez. **Material e Métodos:** o peso do feto foi determinado por ultrassonografia 222 As gestantes, consequentemente, foram divididas em dois grupos: grupo A: peso normal do feto e grupo B: abaixo do peso fetal normal. Sua condição periodontal foi examinada por meio de índice de placa (IP), gengival índice (GI), Sangramento na sondagem (BOP) e Perda de Inserção Clínica (CAL) usando a sonda periodontal CPITN da OMS. Os gráficos da OMS de peso fetal normal para cada semana foram considerados para determinar a normalidade do peso feto. **Resultados:** obteve-se valor significativo p=0,00 quando comparados os parâmetros periodontais examinados entre nos grupos A e B, as médias dos parâmetros periodontais do IP, GI e BOP foram maiores no grupo B (1,1964: 1,4541), (1,1877: 1,4925), (0,3553: 1,3748), respectivamente. Q2 e IQR do PI, BOP e GI no grupo A foram (1,190:0,3), (0.30:0.5), (1.160:0.3) respectivamente.E (1.460:0.24) (1.50:0.7) (1.460:0.26) no Grupo B. Houve 4 casos de CAL no grupo A em oposição a 88 casos no grupo B, Q2 de CAL no grupo A=0,00, Q2 no grupo B=1,00. IQR=0,00 em ambos os grupos. Valor não significativo p=0. 503(p>0,05) foi observado quando comparada a

incidência de baixo nível fetal peso entre os três trimestres. **Conclusão:** é importante manter uma boa condição periodontal e Estado de higiene bucal em gestantes para maior peso fetal e gravidez mais saudável com menos complicações.

PALAVRAS-CHAVE

Higiene bucal; Fatores de risco; Gravidez; Peso fetal; Doença periodontal.

INTRODUCTION

Periodontal health condition can be looked upon as a mirror for general health, many correlations and two-way impacts were discovered between periodontal diseases and a wide variety of systemic diseases such as: coronary heart diseases, diabetes mellitus, rheumatism and so many more [1].

These correlations can be traced back to the fact that most periodontal pathogens have the ability to either enter blood stream travelling to different organs and tissues or its toxins (whether endotoxins or exotoxins) can damage directly or indirectly host tissue and cells [2,3].

One of the pictures of how periodontal condition can impact systemic condition, is what happens during pregnancy. Despite being a multifactorial disease, with the dental plaque accumulation as the major causative factor [3], it is a well-established fact that pregnancy promotes periodontal disease. This contradiction can be explained by the elevation in certain hormones and inflammatory mediators levels such as IL-6, CRP, TNF-α and progesterone in blood and gingival sulcular tissue leading to exaggeration in Immune/inflammatory responses to dental plaque [4,5], and in the same time providing extra nutrients for several periodontal pathogens like *Prevotella intermedia* and *Prevotella nigrescens* [6].

Several researches have backed the idea of the paramount importance of plaque control when combined with systemic conditions [7] This exaggerated inflammatory response to periodontal plaque should be counteracted with magnifying oral hygiene measures, otherwise the diseased periodontium will negatively affect both the mother and the growing fetus in her womb [8].

Raising awareness in this direction (the health of fetus) may improve the outcome of oral hygiene and plaque control in pregnant women,

thus many mothers if not all of them prioritize the health of their child over their own [9].

Estimation of fetus weight has several clinical significances, abnormal/low pre-natal weight can be linked to several neonatal disorders such as: developmental and neurological disorders and might also be related to perinatal morbidity [10].

Literature was not empty from debate around the accuracy of ultrasound measurement of fetus weight, several researchers mentioned some inaccuracies of this method when compared to actual fetus weight at birth and attributed these discrepancies to several factors such as: high maternal BMI, late gestation, insufficient training and experience of examiners and poor optimization of the ultrasound image [11].

Although alternative clinical methods were suggested to estimate pre-natal fetus weight with reasonable outcomes such as Johnson's formula, that is useful especially for rural areas where access to sonography is not quite easy [10].

Other alternatives such as Leopold's measurement -which is a bit old technique described by the German gynecologist Christian Gerhard Leopold- was also used, still the most accepted method that obtained better accuracy with reliability is the ultrasound measurement [12].

In accordance to the subject's importance, World Health Organization (WHO) has published a chart for estimated healthy fetal weight with variations of outcome in different regions of the globe, we depended on this chart as a tool to rule out the normal fetal weight from the abnormal (whether below or above normal weight) (Table I) [13].

Periodontal diseases fall into two major segments: the irreversible form (periodontitis) and the reversible less serious condition (Gingivitis), the difference between the two of them is the term (loss of attachment) [7,14].

Bleeding on probing and change in gingival color and/or contour can be considered the

Table I - WHO multinational estimated fetus weight chart

Gestational age	Length (US) Cranium to rump	Weight (US)	Length (cm) Cranium to rump	Mass (g)
10 weeks	1.22 inch	1.23 ounces	3.1 cm	35 grams
11 weeks	1.61 inch	1.59 ounces	4.1 cm	45 grams
12 weeks	2.13 inches	2.05 ounces	5.4 cm	58 grams
13 weeks	2.64 inches	2.58 ounces	6.7 cm	73 grams
14 weeks	5.79 inches	3.28 ounces	14.7cm	93 grams
15 weeks	6.57 inches	4.13 ounces	16.7 cm	117 grams
16 weeks	7.32 inches	5.15 ounces	18.6 cm	146 grams
17 weeks	8.03 inches	6.38 ounces	20.4 cm	181 grams
18 weeks	8.74 inches	7.87 ounces	22.2 cm	223 grams
19 weeks	9.45 inches	9.63 ounces	24.0 cm	273 grams
20 weeks	10.12 inches	11.68 ounces	25.7 cm	331 grams
21 weeks	10.79 inches	14.07 ounces	27.4 cm	399 grams
22 weeks	11.42 inches	15.17 ounces	29.0 cm	430 grams
23 weeks	12.05 inches	1.10 pounds	30.6 cm	501 grams
24 weeks	12.68 inches	1.32 pounds	32.2 cm	600 grams
25 weeks	13.27 inches	1.46 pounds	33.7 cm	660 grams
26 weeks	13.82 inches	1.68 pounds	35.1 cm	760 grams
27 weeks	14.41 inches	1.93 pounds	36.6 cm	875 grams
28 weeks	14.80 inches	2.22 pounds	37.6 cm	1005 grams
29 weeks	15.47 inches	2.54 pounds	39.3 cm	1153 grams
30 weeks	15.95 inches	2.91 pounds	40.5 cm	1319 grams
31 weeks	16.46 inches	3.31 pounds	41.8 cm	1502 grams
32 weeks	16.93 inches	3.75 pounds	43.0 cm	1702 grams
33 weeks	17.36 inches	4.23 pounds	44.1 cm	1918 grams
34 weeks	17.83 inches	4.73 pounds	45.3 cm	2146 grams
35 weeks	18.23 inches	5.25 pounds	46.3 cm	2383 grams
36 weeks	18.62 inches	5.78 pounds	47.3 cm	2622 grams
37 weeks	19.02 inches	6.30 pounds	48.3 cm	2859 grams
38 weeks	19.41 inches	6.80 pounds	49.3 cm	3083 grams
39 weeks	19.72 inches	7.25 pounds	50.1 cm	3288 grams
40 weeks	20.08 inches	7.63 pounds	51.0 cm	3462 grams
41 weeks	20.39 inches	8.35 pounds	51.8 cm	3787 grams

clinical signs of Gingivitis, on which feedback is given to the patient that he or she should put more effort into the plaque control measures [7].

The periodontitis can be measured clinically by means of probing pocket depth, clinical attachment level (CAL) and mobility. These are the clinical signs that gives us an indication that periodontal disease has reached the irreversible stages of periodontitis [15].

The null hypothesis suggests absence of difference between periodontal parameters in pregnant women of the two groups: A (normal fetus weight) and B (low fetal weight), in order to test the hypothesis, periodontal condition of pregnant women was examined, indexed in correlation with fetus weight then studied statistically.

Aim of this research was to focus more on the urge to include maternal oral hygiene among the health/medical parameters that are being monitored during pregnancy with the same level of attention. Another null hypothesis was tested that states that there isn't a difference between trimesters regarding normal/abnormal fetus weight in examined mothers.

MATERIALS AND METHOD

Principles of Helsinki's declaration was carefully followed in this research, a signed letter of consent was included with the data of every patient.

Patient's selection, examination and exclusion

Two hundred twenty two Pregnant women who attended private Gynecology clinic participated in this research, complete blood picture was obtained for all women, testing of blood pressure and random blood sugar as well as accumulative blood sugar. After examination of fetus weight using ultrasonic device model Fuuda denshi uf-400AX Japan, they were divided into two groups based on fetus weight:

Group A: Pregnant women with normal fetus weight

Group B: Pregnant women with abnormal (below) normal fetus weight (Figure 1).

Exclusion criteria:
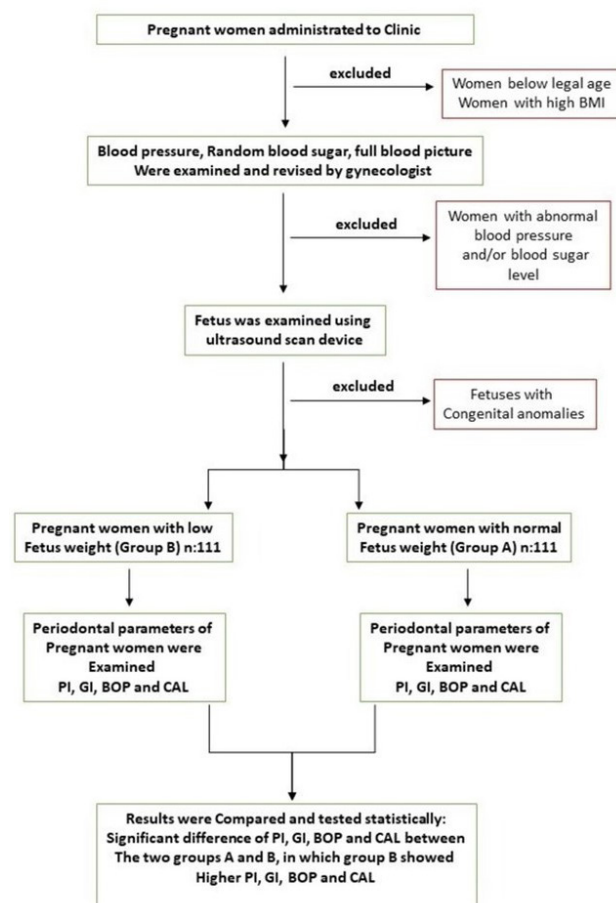1- Women with abnormal blood pressure and/ or blood sugar level.
2- Women with fetal anomalies.
3- Women under legal age for marriage.
4- Women with above average BMI.

Periodontal status (Plaque index, Gingival index, Bleeding on probing index and Clinical attachment loss) of each woman from each group was examined using a CPITN WHO probe and dental mirror.

Double Blind technique

Each patient had two readings, one by the dentist who examined the periodontal status and another by the Gynecologist who estimated fetus weight. None of them (neither the dentist nor the gynecologist) knew the readings of the other. Then the two readings (the periodontal parameters and the estimated fetus weight) were unified in statistical analysis stage. This was performed to rule out bias, especially by the dentist; if he had known the condition of the fetus prior to periodontal examination. Names of patients were covered and only numbers were used to identify the samples.

Plaque index (PI)

It's an index designed by Löe et al. [16] to measure the level of plaque accumulation on teeth surfaces, it is considered as a measurement of patient's commitment with plaque control measures and an indicator for good/bad oral hygiene [7,16].

It is composed of the following scores:
0: No plaque is evident neither by naked eye nor by periodontal probe [16];
1: Plaque can be seen on periodontal probe only [16];
2: Plaque can be seen with naked eye and doesn't exceed one third of crown [16];
3: Plaque exceeds one third of crown [16].

Gingival Index (GI)

In order to examine the extent of gingival inflammation [17], using the CPITN probe, a gentle it has the following scores:
0: Normal gingival color, contour and absence of bleeding on probing [17];
1: Abnormal gingival color, contour and absence of bleeding on probing [17];
2: bleeding on probing that is intermittent [17];
3: sever or continuous bleeding on probing [17].

Figure 1 - Patient flow chart.

Bleeding on probing (BOP)

To rule out presence of bleeding as a sign of gingivitis more objectively, Bleeding on Probing was used in which a gentle circular movement of the WHO periodontal probe's tip is swept around the tooth while observing the presence/absence of bleeding [18]. Scores of this index:

0: No bleeding [18];

1: presence of bleeding [18].

Clinical Attachment Loss (CAL)

To measure the level of attachment loss clinically, a reference point (cement-enamel junction) is chosen to represent the "zero" level; using the WHO calibrated periodontal probe, 3mm distance apical to this point is considered clinical attachment loss with exclusion of attachment loss related to traumatic injuries, or due to malposition or the attachment loss distal to the second molar due to extraction of third molar [19].

Only the presence/absence of Clinical Attachment Loss was measured, so the patient who expressed a ≥3mm distance between the cement-enamel junction and the pocket's apical end was recorded positive, otherwise the patient was considered without clinical attachment loss.

Statistical analysis

Data were tested statistically using IBM SPSS Statistics. Software version: 26. Null hypothesis suggested that there is no difference between the periodontal parameters of the pregnant women in groups A and B.

Normality test: In-order to test the distribution of data kromogolov-Smironov test was used.

Mann-Whitney U test was used to test the significance of difference between group A and group B in periodontal parameters (PI, GI and BOP).

Chi-square test was used regarding the significance of difference between the two groups concerning the clinical attachment loss.

RESULTS

222 samples were divided into two groups, group A and Group B; group A = mothers of fetus with normal weight, Group B = mothers of fetus of below normal weight. Each group had 111 samples.

Normality test

Data were tested for normality, using kromogolov-Smironov test, the value of significance was P=0.00, thus we denied the hypothesis of normal distributed data, indicating a non-parametric data with abnormal distribution. (Table II).

**Table II -** Kolmogorov-Smirnov normality test for distribution of Data

	KOLMOGOROV-SMIRNOV		
	Statistic	Difference	Significance
PI*	0.090	222	0.000****
BOP**	0.174	222	0.000****
GI***	0.092	222	0.000****

*PI: Plaque index. **BOP: Bleeding on probing. ***GI: Gingival inde=x
****p < 0.05 are considered significant.

Table III - Descriptive statistics of mean of PI, GI, BOP and incidence of clinical loss of attachment of both groups.

	NORMAL WEIGHT FETUS	UNDERWEIGHT FETUS
MEAN OF MOTHER'S PI*	1.1964	1.4541
MEAN OF MOTHER'S GI**	1.1877	1.4925
MEAN OF MOTHER'S BOP***	0.3553	1.3748
CLINICAL LOSS OF ATTACHMENT INCIDENCE	4	88

*PI: Plaque index. **GI: Gingival index. ***BOP: Bleeding on probing.
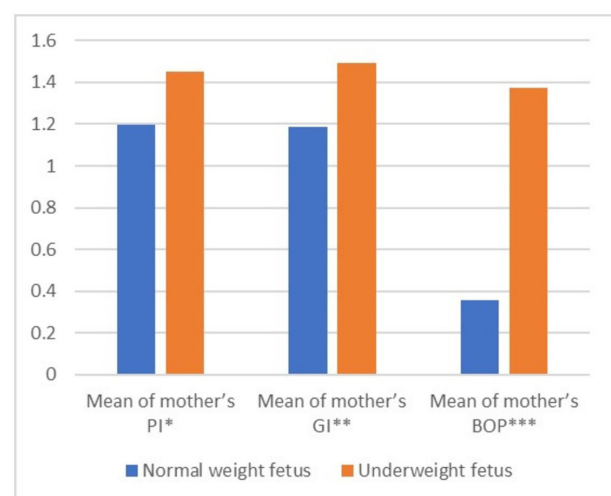
Figure 2 - Comparison of PI, GI and BOP between group A: healthy fetus weight's mothers and Group B: low fetus weigh's mothers. *PI: Plaque index; **GI: Gingival index; ***BOP: Bleeding on probing.

PI

The mean value of PI in group A (1.1964) was lower than that of group B (1.4541), Figure 2 and Table III, p value = 0.00, Table IV. The value of middle quartile (Q2) of PI in group A =1.190 and the inter quartile range (IQR) also known as (Q1-Q3) = 0.3 Figure 3 and Table V. Middle quartile (Q2) value of group B =1.460 and IRQ=0.24, Figure 4 and Table VI.

GI

The mean value of GI in group A was (1.1877) is also lower than mean value of GI of group B (1.4925), Figure 2 And Table III, p value = 0.00, Table IV. Middle quartile (Q2) value of group A = 1.160 and the IQR is (0.3), Figure 5 and Table V. The middle quartile (Q2) of group B =1.460 and its IQR is 0.26, Figure 6 and Table VI.

BOP

Mean value of BOP in Group A was (0.3553) which is less than that in Group B (1.3748), Figure 2 and Table III, p value = 0.00, Table IV.

Q2 in group A = 0.30 and the IQR is 0.5 Figure 7 and Table V, while in group B: Q2= 1.50 and the IQR=0.7, Figure 8 and Table VI.
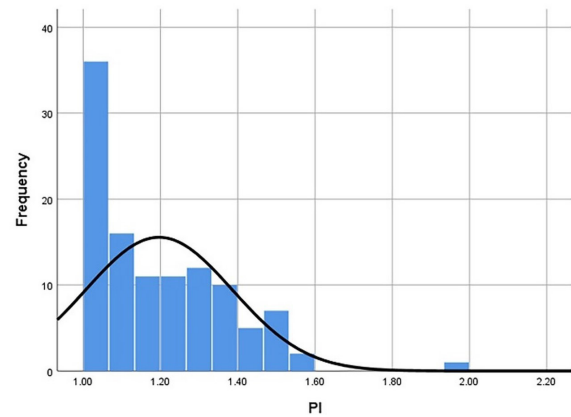
Figure 3 - Quartiles and distribution of Plaque index values of Group A samples (normal fetus weight).
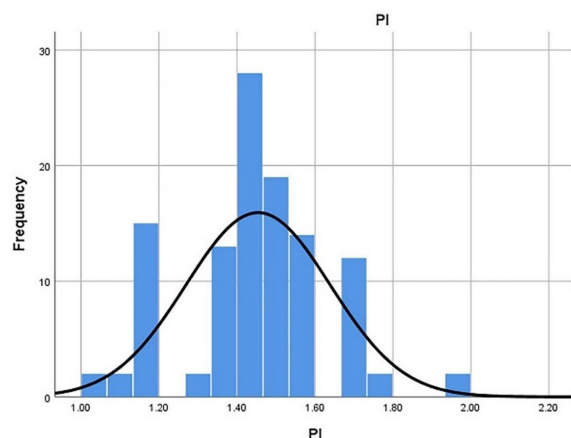
Figure 4 - Quartiles and distribution of Plaque index values of Group B samples (below normal fetus weight).

Table IV - Mann-Whitney U test for the two independent groups regarding PI, GI and BOP variables

	PI*	BOP**	GI***
MANN-WHITNEY U	2020.000	833.000	1667.000
WILCOXON W	8236.000	7049.000	7883.000
Z	-8.687	-11.175	-9.426
ASYMP. SIG. (2-TAILED)	0.000****	0.000****	0.000****

*PI: Plaque index. **BOP: Bleeding on probing. ***GI: Gingival index. ****p < 0.05 are considered significant.

Table V - Means and quartiles of the periodontal parameters of pregnant women with normal weight fetuses

|		*PI	**BOP	***GI	****CAL
MEAN		1.1964	0.3553	1.1877	0.0360
QUARTILES	25	1.0000	0.0000	1.0000	0.0000
	50	1.1900	0.3000	1.1600	0.0000****
	75	1.3000	0.5000	1.3000	0.0000****

*PI: Plaque index. **BOP: Bleeding on probing. ***GI: Gingival index. ****CAL: clinical attachment loss. ****p < 0.05 are considered significant.

Table VI - Means and quartiles of the periodontal parameters of pregnant women with below normal weight fetuses
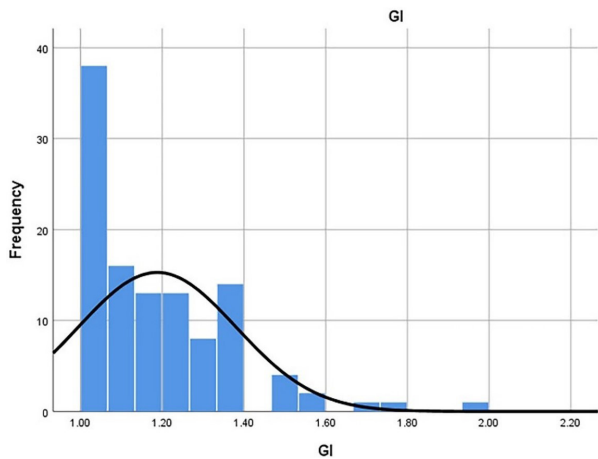
		*PI	**BOP	***GI	****CAL
MEAN		1.4541	1.3748	1.4925	0.7928
QUARTILES	25	1.3600	1.0000	1.3400	1.0000
	50	1.4600	1.5000	1.4600	1.0000
	75	1.6000	1.7000	1.6000	1.0000

*PI: Plaque index. **BOP: Bleeding on probing. ***GI: Gingival index. ****CAL: clinical attachment loss.

Figure 5 - Quartiles and distribution of Gingival index values of Group A samples (normal fetus weight).
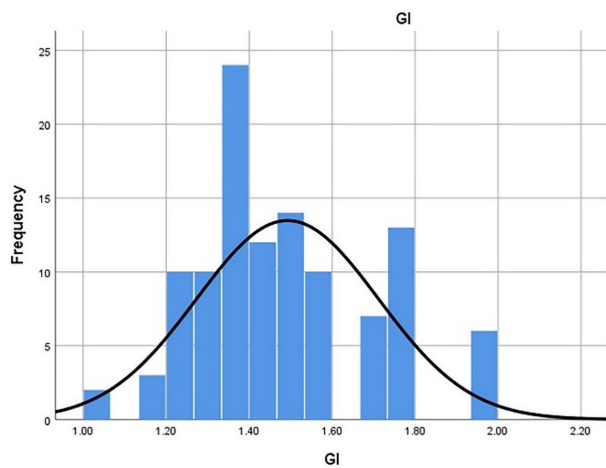

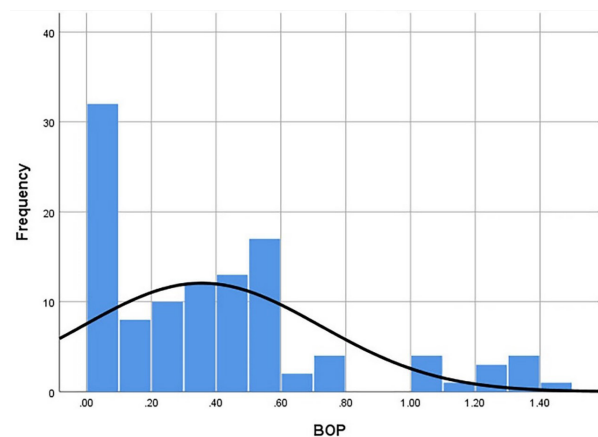**Figure 6 -** Quartiles and distribution of Gingival index values of Group B samples (below normal fetus weight).

Figure 7 - Quartiles and distribution of Bleeding on probing values of Group A samples (normal fetus weight).

Figure 8 - Quartiles and distribution of Bleeding on probing values of Group B samples (below normal fetus weight).

Figure 9 - Comparison of Clinical attachment loss incidence between Group A: normal fetus weight's mothers and Group B: low fetus weigh's mothers

Figure 10 - Quartiles and distribution of Clinical attachment loss values of Group A samples (normal fetus weight).

CAL

In group A only 4 cases were found suffering from clinical loss of attachment as opposed to 88 cases in group B, Figure 9 and Table III,
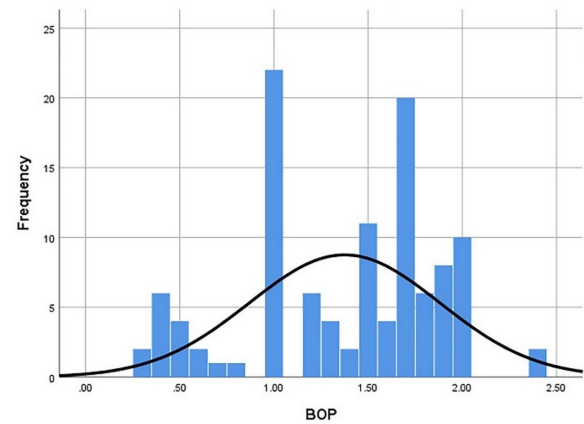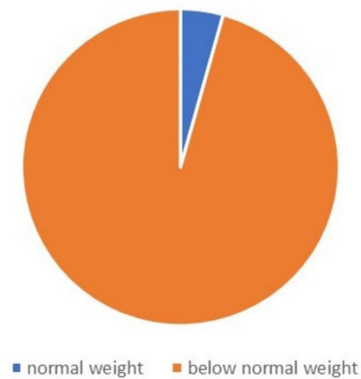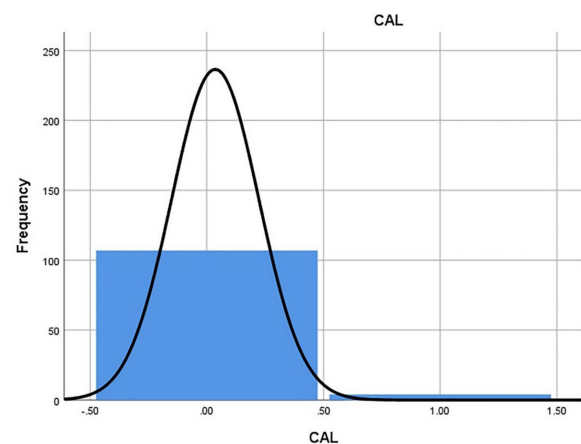
p value = 0.00, Table VII. Q2 of group A was (0.00) and IQR= 0.00, Figure 10 and Table V. While Q2=1.00 and IQR= 0 in group B, Figure 11 and Table VI. (IQR=0 since there are only two limits Q1=0.00 and Q3=0.00 in group A, Q1and Q3=1 in group B).

Table VII - Chi-square test of clinical attachment loss between the two groups

CHI-SQUARE TESTS					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
PEARSON CHI-SQUARE	130.973	1	0.000*		
CONTINUITY CORRECTIONB	127.873	1	0.000*		
LIKELIHOOD RATIO	153.509	1	0.000*		
FISHER'S EXACT TEST				0.000*	0.000*
LINEAR-BY-LINEAR ASSOCIATION	130.383	1	0.000*		
N OF VALID CASES	222				

*p < 0.05 are considered significant.
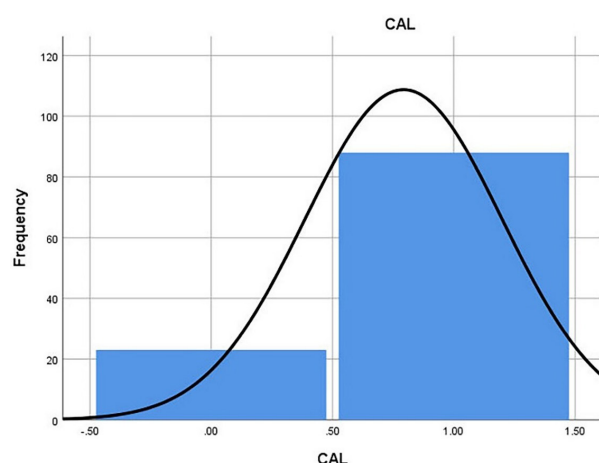
Figure 11 - Quartiles and distribution of Clinical attachment loss values of Group B samples (below normal fetus weight).
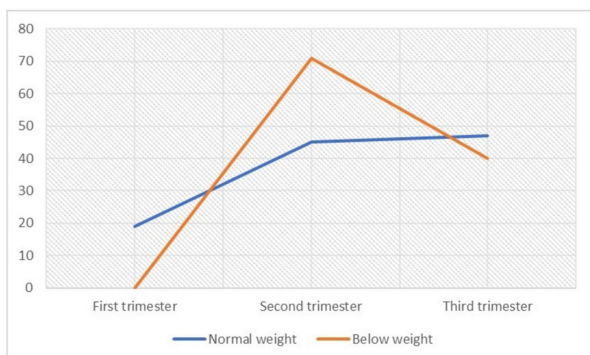
Figure 12 - Distribution of low weight fetuses and normal weight fetuses on the three main pregnancy trimesters.

Comparison between trimesters

When taking the trimesters in which pregnant women were during periodontal examination, it was found that mothers in first trimester didn't have any incidence of abnormal fetus weight, the highest recorded cases of abnormal weight fetuses was in the second trimester (71 cases), while the mothers in third trimester showed the highest number of normal weight fetuses (47) (Table VIII) and (Figure 12).

Table VIII - Descriptive statistics of trimesters of the examined pregnant women

	NORMAL WEIGHT	BELOW WEIGHT	TOTAL
FIRST TRIMESTER	19	0	19
SECOND TRIMESTER	45	71	116
THIRD TRIMESTER	47	40	87
TOTAL	111	111	222

Table IX - Mann-Whitney U test for the correlation between trimesters and fetal weight

MANN-WHITNEY U	5874.500
WILCOXON W	12090.500
Z	-.670
ASYMP. SIG. (2-TAILED)	0.503

These results however have failed to obtain a significant difference when tested statistically P>0.05, thus hypothesis of absence of difference between trimesters regarding fetus weight was not denied (Table IX).

DISCUSSION

Periodontal diseases are known to be caused by several pathogenic bacteria such as (*Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia* ...etc.) and manifests itself as inflammatory process that is either confined to the gingiva namely gingivitis, or extends to the underlying supporting apparatus to be known as periodontitis [7,20].

These micro-organisms can provoke directly or indirectly inflammation through several

inflammatory mediators [21] such as PGE2 which was isolated from the gingival crevicular fluid and saliva of pregnant women in their 7th and 8th month of pregnancy [22].

Other biomarkers like 8-OHdG have the ability to cause dagame to DNA though disturbance of oxidants/antioxidants balance or what is known as oxidative stress.

Tumor necrosis factor alpha (TNF-α) interleukins (IL-6, 1 β) are other inflammatory mediators that are associated with periodontal diseases and on the same time were linked to pregnancy problems such as preterm births (PTB) [23].

Our findings (Figure 2) that was proven statistically line with these assumptions, in a way that the worse the periodontal parameters were, there was a low fetus weight detection.

This was also the case in the meta-analysis and systemic review that was run by Corbella et.al in 2016, involving 17035 subjects from 22 different studies. In this review; a significant correlation between adverse pregnancy outcomes and periodontal disease was found [24].

These findings contradicted an older study which was conducted in 2012 by Srinivas and Parry who didn't find a significant relationship between periodontal diseases and pregnancy [25].

Although there was a raise in the incidence of low fetus weight among women in their second trimester (Figure 12) we failed to prove a statistical difference.

There is a growing body of literature that supports the concept of maintaining an inflammation -free environment for the fetus to grow up, this can be achieved through maintaining a good balance between the pro-inflammatory cytokines and anti-inflammatory cytokines [26], a shift towards inflammatory cytokines like (IL-6, IL-1, TNF, GM-CSF, G-CSF) was evident in patients with periodontal disease. Inducing osteoclasts activity and local tissue destruction by chemokines like matrix metalloproteinase, RANKL and VEGF promotes the progression of disease [27].

The pro-inflammatory trophoblastic response by the growing embryo, can lead into restriction of passage of nutrients and oxygen through placenta to the growing fetus, which will consequently affect the normal growth process and might lead to increase in chronic disease risk in adulthood [28,29].

CONCLUSION

Deterioration of periodontal status in pregnant women is associated with low fetal weight as seen in ultrasound scanning. Not only biofilm control measures should be implemented but also an active periodontal treatment is recommended.

Author's Contributions

ARA: Methodology, data analysis, writing and reviewing, corresponding author. ABK: Data collection, participation in patients examination, logistics and access to gynecological clinics. BHA: Data collection, participation in patients examination.

Conflict of Interest

The authors of this research declare that there is no conflict of interest to disclose.

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Regulatory Statement

This research was approved by the medical ethics committee of University of Mashreq/ College of Dentistry that was given in order no.218 dated 1/10/2023.

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Ali Raad Abdulazeez
(Corresponding address)
University of Mashreq, Baghdad, Iraq.
Email: dr.aliraad1986@gmail.com