The correlations between periodontal disease in the woman with pregnancy and low birth weight infant: a systematic review

Hubungan antara penyakit periodontal pada wanita hamil dengan berat bayi lahir rendah: kajian sistematik

[1]Ira Farwiany Syafar, [2]Hasanuddin Tahir, [2]Sri Oktawati
[1]Postgraduate Professional Education Student of Periodontology
[2]Department of Periodontology
Faculty of Dentistry, Hasanuddin University
Makassar, Indonesia
E-mail: irafsdrg@gmail.com

ABSTRACT
Objective: To study the correlations of periodontal disease in the woman with pregnancy and low birth weigth infant (LBWI). **Methods**: Pubmed and Wiley online searches were conducted to identify articles published in dental journals from January 2013 to November 2018 focusing on pregnancy women and LBWI and its correlations with periodontal disease. Manual searches of published full-text articles and related reviews were performed afterwards. **Result**: The initial database search produced 44 articles. A total 6 studies were selected for inclusion, with total 995 pregnancy women as subjects. All of the studies showed the associations of plaque index (PI), gingival index (GI), probing depth (PD), bleeding on probing (BOP), clinical attachment loss (CAL), gestational age (GA) and birth weight. **Conclusion**: Periodontal disease in the pregnancy women is one risk factor for adverse pregnancy outcomes such as infant low birth weight.
Keywords: periodontal disease, pregnancy, low birth weight, risk factor

ABSTRAK
Tujuan: Untuk mempelajari hubungan antara penyakit periodontal pada wanita hamil dengan berat bayi lahir rendah (BBLR). **Metode**: Dilakukan pencarian *online* dengan *Pubmed* dan *Wiley* untuk mengidentifikasi publikasi artikel dalam jurnal dental dari Januari 2013 sampai November 2018 yang berfokus pada wanita hamil dan BBLR serta hubungannya dengan penyakit periodontal. Pencarian secara manual dari artikel teks lengkap yang telah dipublikasi dan ulasan terkait dilakukan setelahnya. **Hasil**: Pencarian basis data awal menghasilkan 44 artikel. Sebanyak 6 studi dipilih untuk dimasukkan, total 995 wanita hamil sebagai subjek. Semua penelitian menunjukkan hubungan indeks plak (IP), indeks gingiva (IG), kedalaman probing (PD), perdarahan saat probing (BOP), kehilangan perlekatan klinis (CAL), dengan usia kehamilan (GA) dan berat lahir. **Simpulan**: Penyakit periodontal pada wanita hamil adalah salah satu faktor risiko untuk hasil kehamilan yang merugikan seperti BBLR.
Kata kunci: penyakit periodontal, kehamilan, berat bayi lahir rendah, faktor risiko.

INTRODUCTION

Maintaining optimal oral health during pregnancy is recognised as an important factor in the immediate and long-term health of women and children.[1] The last 2 decades showed a growing interest in the association between periodontal disease and pregnancy outcomes among the scientific community. This concern arises from observation that despite the advances in prenatal care and increased public awareness, adverse the pregnancy outcomes still present a major public health problem worldwide.[2]

The periodontal diseases are a group of oral inflammatory diseases caused by bacterial plaque and influenced by host response factors.[3] There are two main types; gingivitis which is inflammation of soft tissues or the gingiva surrounding the tooth, and the periodontitis involving apical migration of periodontal ligament attachment and destruction of the connective tissue and alveolar bone that support the teeth.[3] The periodontal disease has been impacted in pathogenesis of these adverse pregnancy outcomes.[2] Periodontal disease represents an infectious disease affecting more than 23% of women ages of 30-54 years [2]. The absence of adequate oral hygiene makes periodontal bacteria accumulate in the gingival crevice of the teeth and form an organized structure known as bacterial biofilm.

Adverse pregnancy outcomes such as preterm birth and low birth weight are major causes of maternal and neonatal morbidity and mortality. Increasing evidence points to an association between periodontal disease and adverse pregnancy outcomes and thus early detection will assist in treatment planning to reduce adverse pregnancy outcomes. It has been reported

that 50-70% of pregnant women develop periodontal disease between the 2nd and 8th month of pregnancy.[4]

In this regard, the proposed link between maternal periodontal disease and preterm low birth weight (PLBW) infant is particularly compelling. First, PLBW has been shown to be associated with infections of genitourinary tract, which do not necessarily involve infection of the fetal-placental unit.[5] Hence, infections remote from the developing fetus have the potential to influence gestation. Secondly, the physiological mediators of parturition include prostaglandin E2 and tumor necrosis factor-alpha (TNF-a), both of which have been shown to be locally elevated as part of the host response to the microbial challenge in periodontal diseases.[5] In the case of TNF-a, systemic levels are also increased in periodontal patients with active disease. Thirdly, despite the considerable progress in describing the risk factors involved in PLBW, a high proportion of PLBW cases have an unexplained etiology.[5]

Periodontal inflammation is known to produce increased secretion of several proinflammatory cytokines found in gingival crevicular fluid (GCF). Most notably, levels of interleukin (IL)-1b, IL-6, TNF-a, and PGE2 are increased.[6] Furthermore, analyses of serum and amniotic fluid at the time of parturition demonstrate elevated proinflammatory markers that have been associated with preterm delivery. Periodontal pathogens and their virulence factors are able to disseminate systemically and induce local and systemic inflammatory responses in host.[6] During pregnancy, these processes can progress to the amniotic cavity, affect placental tissues, and cause disturbances in the maternal–fetal unit. These events can alter fetal development and may lead to premature uterine contractions.[6]

During pregnancy, the prevalence and severity of gingivitis increase throughout the gestational period, and increase in inflammatory signs is disproportionate to the quantity of plaque accumulation. Hormonal changes in pregnancy have been found to be a modifying factor, and bacterial plaque is a necessary primary etiology for gingivitis. In the absence of bacterial challenge, gingival tissues can remain in a healthy state during pregnancy. A positive correlation was also observed between an overgrowth of *Porphyromonas gingivalis, Tannerella forsythia,* and *Campylobacter rectus* and an increase in estradiol concentrations.[6]

Low birth weight (LBW), defined as birth weight less than 2,500 g, is a major public health problem in both developed and developing countries. The incidence of LBW in the US steadily declined in the 1970s and subsequently increased in the 1990s. There were over 250,000 (7,3%) LBW babies among the 3.9 million babies born in the US in 1995.[6] Globally, about 16% (more than 200 million) of the babies born in the world in 1982 were LBW babies.[7] Disorders relating to short gestation and LBW are among the leading causes of death in infants.[7]

Oral health has been associated with pregnancy for generations based on empirical observations and anecdotal reports. The famous saying "a (loss of a) tooth for every child" is still heard in many parts of the world. The dental health status of the pregnant woman, the effect of pregnancy on the oral health status of the pregnant woman, and the effect of LBW on the oral health of the child have been previously reported.[7] However, the association of the oral health status of pregnant women to LBW of the newborn has been subjected to investigation only recently. The objective of the present study was to determine the correlation between periodontal disease in the woman with pregnancy and infant LBW.

METHODS

This systematic review was written according to the guidelines of preferred reporting items for systematic reviews and meta-analyses (PRISMA) for reporting studies evaluating healthcare interventions. Population, intervention, control, outcome (PICO) question of the present systematic review was P women with pregnancy, I periodontal disease, C periodontal measurement, O delivery outcome with LBW infant.

Initial Pubmed and Wiley search of the English language literature was performed to establish a study protocol. These searches were conducted to identify articles published in dental journals from January 2013 to November 2018 focusing on study of pregnancy women and LBW infant and its correlations with periodontal disease. The MeSH (NCBI PubMed) keywords used were "pregnancy" and **"**LBW infant" and "periodontal disease". The search limits applied to the electronic search were the article types, search period. Manual searches of published full-text articles and related reviews were performed afterwards. There are 38 studies have shown on this matter in Pubmed, and 6 studies in Wiley, with only 6 studies met the inclusion criteria. Specific keywords were used to identify the appropriate studies needs, and followed the characteristics of PICO question. The inclusion criteria in this systematic review were English language article, full text article, any clinical study published between January 2013 to November 2018, the studies reported about periodontal measurement on women pregnancy, the studies included information about LBW and its correlation with periodontal

disease, the studies included a clinical evaluation of the pregnancy outcome with associated periodontal disease.

The exclusion criteria were all studies which did not satisfy the above mentioned criteria, such as animal studies and systematic review and meta analysis.

Specific keywords were used by two participating authors (HS and SO) resulted the selection of the papers based on reading of abstract and full-texts. Independently, two investigators selected the paper based on inclusion criteria formerly set. After that, all abstracts and full-texts were downloaded and individually evaluated. The eligibility criteria were used to identify the articles that will be used for this systematic review.

The data were retrieved by the two reviewers (HS and SO) that regarding following parameters: authors, year of publication, number of patients, technique, and objective. All of the full-texts which met the inclusion criteria were read independently by two reviewers, and evaluated to formulate this systematic review.

RESULT

The database search yielded 44 references, including 38 from PubMed and 6 from Wiley. After removing duplicates references and all the exclude criteria, there were 20 studies remained. The titles and abstracts were reviewed afterward, and 6 studies were eligible for further analysis. The full-texts then be reviewed by the investigators and yielded 6 articles which met the inclusion criteria. The flowchart of article selection is shown in figure 1 with total 6 selected articles from initial yield of 44 studies by electronic literature search. After 44 titles reviewed, 20 articles were selected for this systematic review inclusions, whereas the other 14 articles were excluded for some different reasons.

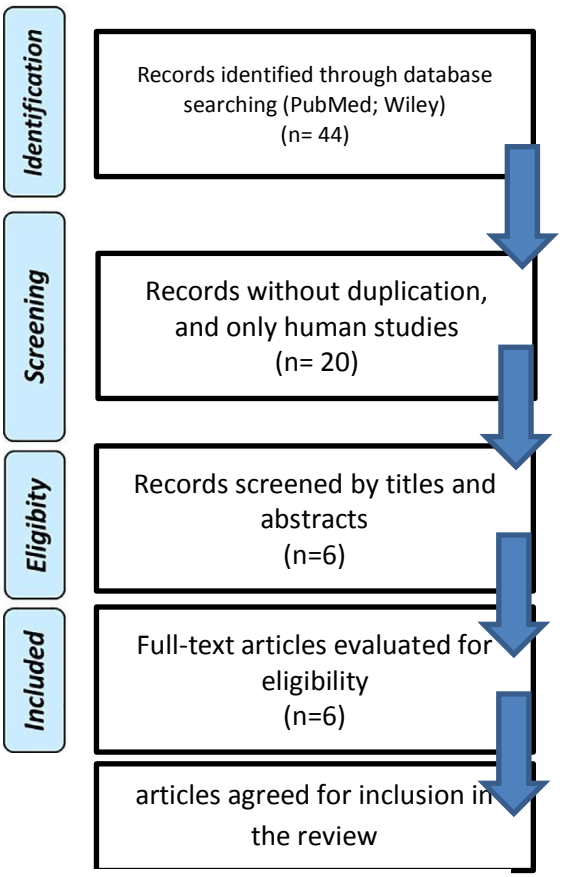

Figure 1 Article selection flow chart

The six studies were published between 2013 and 2017. The number of participants in the studies were 995 women with pregnancy. All of the studies showed the periodontal paramenter which include plaque index (PI), gingival index (GI), probing depth (PD), bleeding on probing (BOP), clinical attachment loss (CAL), gestational age (GA) and birth weight.

Meqa et al showed mean (SD) values in all periodontal paramenters between normal birth weight (NBW) and low birth weight (LBW) such as dental PI was 2.25±0.58 (NBW) and 2,48±0,54 (LBW), GI was 1.70±0.27 (NBW) and 1.79±0.17 (LBW), BOP (%±SD) was 71.00±22.80 (NBW) and 77.30±20.10 (LBW), periodontal pocket depth was 2.27±0.50 (NBW) and 2.46±0.47 (LBW), CAL was 2.33±0.65 (NBW) and 2.51±0.50 (LBW) and gingival recession was 0,07 ±0.27 (NBW) and 0,06±0,07 (LBW). Meqa et al also showed the subjects who gave birth to low-weighted babies had significantly higher dental PI (p=0.03) as well as deeper periodontal pockets (p=0.028). The CAL was also significantly higher (p=0.025).

Turton et al showed mean (SD) values periodontal parameters such as dental PI was 2.17±0.64, GI was 2.44±0.58, and CAL was 1.69±0.62. Turton also show that the dental PI and GI were significantly associated with pregnancy stage and PD, but PI and GI scores did not differ significantly between race grup or between the different educational levels. PD showed significant correlation with CAL, $p < 0.001$ and periodontal disease. CAL also showed significant association with race, $p<0.001$ and periodontal disease.

Bulut et al showed mean (SD) values periodontal parameter such as periodontal pocket depth of patients with periodontitis was 4.17±0.30 and CAL of patients with periodontitis was 3.69±0,36. Bulut et al also showed mean (SD) values the comparison data of periodontally healthy women and women with periodontitis within normal term normal birth weight (NTNBW) and preterm low birth weight (PTLBW) and also GA. Birth weight with periodontal disease was 3221±368 (NTNBW), birth weight with periodontally healthy was 3202±551 (NTNBW), and

birth weight with periodontal disease was 1770±540 (PTLBW), birth weight with periodontally healthy was 1660±556 (PTLBW). GA (week) with periodontal disease was 39.4±1.18 (NTNBW), GA with periodontally healthy was 38.7±1.11 (NTNBW), GA with periodontal disease was 31.4±3.1 (PTLBW) and GA with periodontally healthy was 30.9±2.7 (PTLBW).

Tabares et al showed mean (SD) values in all periodontal paramenters between NTNBW and PTLBW such as dental PI was 1.53±0.06 (NTNBW) and 1.58±0.19 (PTLBW), GI was 1.83±0.05 (NTNBW) and 1.88±0.18 (PTLBW), PD was 4.9±0.21 (NTNBW) and 4.76±0.35 (PTLBW), CAL was 2.6±0.18 (NTNBW) and 2.47±0.53 (PTLBW). Usin et al also showed mean (SD) infant weight (g) 3128±330 (NTNBW), 2005.3±120 (PTLBW), and GA (week) was 38±0.14 (NTNBW), 34±0.6 (PTLBW).

Reddy et al (2014) showed Mean (SD) values in periodontal paramenters between before delivery (bd) and after delivery (ad) in pregnant women with periodontitis and received periodontal therapy such as OHI was 4.2±1.1 (bd), 1.0±1.1 (ad), bleeding index was 3.3±0.8 (bd), 1.2±0.2 (ad), probing depth was 4.5±1.1 (bd), 1.9±0.9 (ad), CAL was 4.9±1.1 (bd) and 2.2±1.9 (ad), and periodontal parameters between bd and ad in pregnant women periodontitis, received only oral hygiene instructions such as OHI was 5.0 ±0.7 (bd), 4.8±0.7 (ad), bleeding index was 3.8±0.8 (bd), 3.3±0.8 (ad), probing depth was 4.9±0.8 (bd), 4.4±0.9 (ad), CAL was 5.0±0.7 (bd) and 4.7±0.7 (ad).

Pirie et al showed mean (SD) values in periodontal paramenters who received periodontal therapy (pt) and only oral hygiene instruction (ohi) such as PI was 121±27 (pt) and 114±29 (ohi), PD was 36.2±18.6 (pt), 34.9±17.7 (ohi), bleeding on probing was 118± 21 (pt) and 119±25 (ohi), CAL was 35.5±18.3 (pt) and 31.3±14.7 (ohi).

DISCUSSION

Meqa et al reported the investigation has found a significant correlation between periodontitis and LBW, as well as between periodontitis and preterm birth. The adjusted odds for women with periodontitis to have low weighted off spring were 3.2 times higher than for women without periodontitis. Also, the same adjusted odds for women with periodontitis to give birth prematurely were 3.4 times higher than for women without periodontitis.[8] It means that women with periodontal disease were at risk 3.2 times more frequently for delivering a LBW off spring and were at risk 3.4 times more frequently for delivering prematurely than women without periodontal disease.

Numerous studies have identified the following risk factors for PLBW: mother's age (under 17 and over 35 years), low socioeconomic level, alcohol, drugs, African-American race, low prenatal care, smoking, multiple pregnancy, genitourinary tract infections, mother's systemic diseases (hypertension, eclampsia, preeclampsia, gestational diabetes). However, those risk factors were not present in 25% of the cases with PLBW.[8] The basic clinical parameters for measuring the severity of periodontal disease (PD) are clinical attachment level (CAL) and pocket probing depth (PPD) together with gingival bleeding and radiological evaluation of osseous resorption.[8]

During pregnancy, changes in hormone levels promote an inflammatory response that increases the risk of developing gingivitis and periodontitis, two forms of periodontal disease involving the gingivae and alveolar bone, respectively. Several risk factors for preterm birth of LBW infants have been identified, including extremes of maternal age, ethnicity, low socioeconomic status, nutritional status during pregnancy and infection.[9]

Although there is concede that LBW may not always be attributed to periodontal disease, Turton et al study increased maternal periodontal disease severity was correlated with a decrease in the number of infants delivered with normal birthweight, while the number of LBW infants increased significantly in the presence of maternal periodontal disease, in accordance with the results of other studies.[9]

A positive correlation between maternal periodontitis and PLBW was originally suggested by Bulut et al and confirmed by many other studies from different countries worldwide. While some of these studies reported a strong association, some could only present limited evidence.[10]

Controversial results in the current literature can be also related to the variation of patient selection and exclusion criteria among different studies. Periodontal diseases share many common risk factors with pre-term delivery and LBW such as age, systemic health status, smoking, poor hygiene habits and low socioeconomic level. Women with systemic medical conditions and obstetric disorders, as well as women who received systemic antibiotics during pregnancy and who had multiple gestation were excluded from the study, since major risk indicators for pre-term birth are related to maternal medical conditions and pregnancy complications. Several authors included such women and observed a positive correlation between periodontitis and preterm LBW.[10]

In Taberas et al study, all patients were of low socioeconomic status, with no racial differences, and

Table 1 Descriptive data from clinical parameters (mean ± SD) of PI, GI, BOP, PPD, CAL, GA and birth weight

Author	Subject	infant	Clinical parameter					Pregnancy Outcome			
								GA		Birth weight	
			PI	GI	BOP	PPD	CAL	Periodontitis	healthy	Periodontitis	healthy
Meqa et al (2017) [8]	200	NBW	2.25±0.58	1.70±0.27	71.00±22.80	2.27±0.50	2.33±0.65	36.4±4.8	38.6±2.7	2751.4±1008.5	3208.4±682.3
		LBW	2.48±0.54	1.79±0.17	77.30±20.10	2.46±0.47	2.51±0.50	n/a	n/a	n/a	n/a
Turton et al (2017)[9]	442	N/A	2.17±0.64	2.44±0.58	n/a	n/a	1.69±0.62	37.3±2.50		2.99±0.53	
		N/A	n/a	n/a	n/a	n/a	n/a	n/a		n/a	
Bulut et al (2014)[10]	100	NBW	n/a	n/a	n/a	4.11±0.94	3.48±0.86	39.4±1.18	38.7±1.11	3221±368	3202±551
		LBW	n/a	n/a	n/a	4.17±0.30	3.69±0.36	31.43.1	30.9±2.7	1770±540	1660±556
Tabares et al (2014)[11]	134	NBW	1.53±0.06	1.83±0.05	n/a	4.9±0.21	2.6±0.18	38±0.14		3128±330	
		LBW	1.58±0.19	1.88±O.18	n/a	4.76±0.35	2.47±0.53	34±0.6		2005.3±120	
Reddy et al (2014)[12]	20	BD	4.2±1.1	n/a	3.3±0.8	4.5±1.1	4.9±1.1	n/a		n/a	
		AD	1.0±1.1	n/a	1.2±0.2	1.9±0.9	2.2±1.9	n/a		n/a	
Pirie et al (2013)[13]	99	NBW	121±27	n/a	118±21	36.2±13.8	35.5±18.3	n/a		n/a	
		LBW	114±29	n/a	119±25	34.9±17.7	31.3±14.7	n/a		n/a	

BD : before delivery
AD : after delivery
NBW : normal birth weight
LBW : low birth weight
PI : plaque index
CAL : clinical attachment level
PPD : probing depth
N/A : not available

Table 2 Descriptive data from clinical parameters (mean ± SD) of PI, GI, BOP, PPD, CAL, and GA

Author	Subject	infant	Clinical parameter				
			PI	GI	BOP	PPD	CAL
Meqa et al (2017) [8]	200	NBW	2.25±0.58	1.70±0.27	71.00±22.80	2.27±0.50	2.33±0.65
		LBW	2.48±0.54	1.79±0.17	77.30±20.10	2.46±0.47	2.51±0.50
		P	0.03	0.06	0.11	0.028	0.025
Turton et al (2017)[9]	442	N/A	2.17±0.64	2.44±0.58	n/a	n/a	1.69±0.62
		N/A	n/a	n/a	n/a	n/a	n/a
		P	<0.0001	n/a	n/a	n/a	<0.0001
Bulut et al (2014)[10]	100	NBW	n/a	n/a	n/a	4.11±0.94	3.48±0.86
		LBW	n/a	n/a	n/a	4.17±0.30	3.69±0.36
		P	n/a	n/a	n/a	0.545	0.442
Tabares et al (2014)[11]	134	NBW	1.53±0.06	1.83±0.05	n/a	4.9±0.21	2.6±0.18
		LBW	1.58±0.19	1.88±O.18	n/a	4.76±0.35	2.47±0.53
		P	<0.0008	<0.0008	n/a	<0.0008	<0.0008
Reddy et al (2014)[12]	20	BD	4.2±1.1	n/a	3.3±0.8	4.5±1.1	4.9±1.1
		AD	1.0±1.1	n/a	1.2±0.2	1.9±0.9	2.2±1.9
		P	0.005	n/a	0.005	0.005	0.005
32Pirie et al (2013)[13]	99	NBW	121±27	n/a	118±21	36.2±13.8	35.5±18.3
		LBW	114±29	n/a	119±25	34.9±17.7	31.3±14.7
		P	0.02	n/a	0.02	0.02	0.02

P: significant difference

exhibited varying disease-state periodontal also considered that periodontitis can be associated with preterm LBW infant, only in the presence of behavioral factors, genetic risk factors or age of the mothers. In this research, data collection was performed before the women gave birth. Therefore, periodontitis be evaluated as an independent risk factor for PTLBWI,[11] so there would be consensus that pregnant women are prone to suffer from impaired periodontal health status. Hence, American Academy of Periodontology recommends that all pregnant women, including those planning a pregnancy, should have appropriate periodontal examinations in order to receive appropriate preventive or therapeutic services.[11]

Reddy et al reported that women with periodontitis are two to three times more likely to deliver a pre-term, LBW infant, than periodontal healthy women. the maternal periodontal infection in the absence of a protective maternal antibody response is associated with systemic dissemination of oral organisms that translocate to the fetus, resulting in prematurity. Moreover, the fetal response against periodontal pathogens of the orange complex was identified to be stronger in pre-term neonates than in full-term neonates, establishing a direct intrauterine fetal exposure to bacteria, which might be responsible for the premature and LBW.[12]

The identification of periodontal disease as a potential risk factor for pretem birth and LBW defines a population that could benefit from targeted intervention. This led to the hypothesis that the treatment of maternal periodontal disease, thereby minimizing the effects of periodontal infection during pregnancy, might reduce the incidence of PTB/LBW.[13] It's similar with Dasanayake et al hypothesis that poor oral health of the pregnant woman is associated with LBW of the newborn was tested by using a matched case-control study. Mother's height, lack of prenatal care, and the number of healthy sextants in the mouth emerged as independent risk factors for LBW in the study.

It was conclude that periodontal disease in the women with pregnancy is one leading risk factor for adverse pregnancy outcomes such as LBW. However, this conclusion may need further intervention studies to ensure the correlation between periodontal disease and LBW infant in pregnancy

ACKNOWLEDGMENT

The author would like to express gratitude to the Department of Periodontology, Hasanuddin University for their support to conduct the study.

Conflict of Interest

The authors report no conflict of interest.

Reference

1. Johnson M, George A, Dahlen H. The midwifery initiated oral health-dental service protocol : an intervention to improve oral health outcomes for pregnant women. 2015:1-9.
2. Soroye M. Association between periodontal disease. Odonto-Stomatologie Tropicale 2016; .
3. Muwazi L, Rwenyonyi CM, Nkamba M, et al. Periodontal conditions , low birth weight and preterm birth among postpartum mothers in two tertiary health facilities in Uganda. 2014.
4. Turton MS, Henkel RR, Wilma C, Africa J. ST AC. *Biomarkers*. 2017;0(0):000. doi:10.1080/1354750X.2017.1334151

5. Elizabeth S, Sivapathasundram V, Williams ECS, Sterne JAC, Fearne M, Curtis MA. The East London study of maternal chronic periodontal disease and preterm low birth weight infants : study design and prevalence data. 1998;3(1).
6. Kaur M, Geisinger ML, Geurs NC. Case series effect of intensive oral hygiene regimen during pregnancy on periodontal health, cytokine levels, and pregnancy outcomes : a pilot study. 2014;85(12). doi:10.1902/jop.2014.140248
7. Ananda P. Poor periodontal health of the pregnant woman risk factor for low birth weight.
8. Meqa K, Dragidella F, Disha M, Sllamniku-dalipi Z. Povezanost između parodontne bolesti i prijevremenog porođaja i niske porođajne težine djeteta na Kosovu The association between periodontal disease and preterm low birthweight in Kosovo. 2017;(9):33-40. doi:10.15644/asc51/1/4
9. Turton M, Africa CWJ. Further evidence for periodontal disease as a risk indicator for adverse pregnancy outcomes. :1-9. doi:10.1111/idj.12274
10. Bulut G, Olukman O, Calkavur S. Is there a relationship between maternal periodontitis and pre-term birth ? A prospective hospital-based case-control study. 2014;(16):866-873. doi:10.3109/00016357.2014.919663
11. Tabares S, Parodi R, Usin M, Menso J. Association between maternal periodontitis and preterm and / or low birth weight infants in normal pregnancies. 2014;7058:1-5. doi:10.3109/14767058.2014.987751
12. Reddy BVR, Tanneeru S, Chava VK. The eff ect of phase-I periodontal therapy on pregnancy outcome in chronic periodontitis patients. 2014;(January):29-32. doi:10.3109/01443615.2013.829029
13. Pirie M, Linden G, Irwin C. Intrapregnancy non-surgical periodontal treatment and pregnancy outcome: a randomized controlled trial. J Periodontol 2013; 84: 1391-9;. doi: 10.1902/jop.2012.120572