

# Assessing the association between periodontitis and preterm low birth weight: A case control study

Peace UWAMBAYE (✉ [upeace1602@gmail.com](mailto:upeace1602@gmail.com))

University of Rwanda College of Medicine and Health Sciences <https://orcid.org/0000-0002-8602-5625>

Cyprien MUNYANSHONGORE

University of Rwanda college of Medicine and Health Sciences

Stephen RULISA

University of Rwanda College of Medicine and Health Sciences Huye

Harlan J Shiau

University of Maryland

Assuman NUHU

University of Rwanda college of Medicine and Health Sciences

Michael S KERR

Western University

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## Research article

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# Abstract

## Background

Premature deliveries are the main causes of prenatal and infant mortality and morbidity in developed societies and is an important problem in obstetrics. Maternal periodontitis is a very prevalent condition that has suspected to be associated with adverse pregnancy outcomes like preterm birth and low birth weight. However, there are still conflicting results and this study have been done to determine the association between periodontitis and preterm low birth weight in order to get necessary information that will enable us to improve mothers' and children's health by recommending the screening tool to be used by nurses and midwives to screen for periodontal diseases during antenatal consultations.

## Methods

A case control study was done on 555 women on post-partum period. This case control was in ratio of 1:2; 1 case of preterm and low birth weight to 2 controls. There were 185 cases with preterm deliveries/ gestation age < 37 weeks and low birth weight / weight < 2500 g and 370 controls with term delivery/ gestation age of above or equal to 37 weeks and normal birth weight babies 2500 g and above. Multivariate regression analysis was done and the variables were hierarchically grouped into three groups: first categories of demographic variables were put in the regression model as step 1. Second category were other potential factors were put in regression model as the second step. The third category or the third step of regression model, the researcher put periodontitis as it was hypothesized a major predictor variable.

## Results

Significant association was found between periodontitis and preterm low birth weight; women who had periodontitis had 6 times the odds of giving birth to preterm low birth weight babies compared to women who had no periodontitis ( $p < 0.001$ ) (95% CI 3.9, 10.4).

## Conclusion

Periodontitis is a risk factor for preterm low birth weight and preventive solutions like having a periodontitis screening tool for nurses and midwives during antenatal care consultations are highly recommended.

## Background

Premature deliveries are among the leading causes of antenatal and child mortality and morbidity in developed societies. In the United States, prematurity and associated complication such as immature

lungs, reduced feeding ability, and poor weight gain caused longer hospital stay, medication with more 70% of prenatal and infant mortality. It has been reported that preterm delivery caused around 28,000 babies died before the age of one year in 2011. Almost a quarter of prematurely born babies were admitted in a hospital at least once during the first year of life and the increase in hospitalization frequency has been related to the reduced birth weight from 2000 gm<sup>1</sup>.

Neonatal delivery before 37 weeks of gestation is the main cause of low birth weight<sup>2</sup>. Preterm birth is one of the major health care challenges and is associated with many potential consequences like lifelong disabilities and high health care costs<sup>3</sup>. Preterm birth is the leading cause of neonatal death in low income countries<sup>3</sup>. Premature deliveries are around 12.9 million births worldwide representing around 9.6% of all births with some regional discrepancies. African region reported higher incidences of preterm births (18%) followed by USA (12–13%) and Europe (5–9%). According to DHS 2014–2015 in Rwanda, low birth weight deliveries was 6.3%<sup>4</sup> and according to Rwanda Population Reference Bureau, preterm birth complications are part of the top 10 causes of child mortality in Rwanda<sup>5</sup>.

Different studies have identified various risk factors that are related to preterm low birth weight and these maternal risk factors include age, weight, socio economic status, smoking, multiple pregnancies, low prenatal care, nutrition, stress, genito-urinary tract infections and Malaria. However, 25% of preterm low birth weight cases was of unknown etiology<sup>6</sup>. There are also various studies that reported on possible association between periodontitis and preterm low birth weight. In 1996, Offenbacher and colleagues were the first investigators to find the relationship between maternal periodontitis and premature delivery and later other different authors reported the same findings<sup>8, 9, 10, 11</sup>. Based on recent published literature, three hypotheses have been identified in relation to periodontal bacterial infection and pregnancy outcome. Biological explanations has been hypothesized that including the spread of the germs, the dissemination of the inflammation throughout the body and the activation of the fetomaternal immune system towards the oral pathogens<sup>12</sup>.

In Africa, some studies have associated poor periodontal status with premature birth and low birth weight deliveries. For example, a study done in Nigeria by Umoh and colleagues concluded that the management of periodontal diseases reduced the prevalence of low birth weight deliveries<sup>13</sup>. Although the studies highlighted the association between periodontal infection and the risk of low birth weight, the literature search conducted did not find any study that pointed out about periodontal screening during pregnancy. Therefore, the aim of the current study is to assess the association between periodontitis and preterm low birth weight with long term goal of initiating the screening tool to be used by nurses and midwives for screening of periodontitis during antenatal consultations

## Methods

A case control study was done on 555 women on post-partum period. This case control was in ratio of 1:2; 1 case of preterm and low birth weight to 2 control cases. Each selected case of pre-term and low

birth weight was followed by 2 control cases that were next on the register but are normal gestation weight. In total, there were 185 cases with preterm deliveries/ gestation age of 37 weeks or less and low birth weight/ weight of 2500 g or less and 370 controls with term delivery/ gestation age >37 weeks and normal birth weight babies/ >2500 g.

The study was done in the Southern Province of Rwanda in 6 districts namely; Kamonyi, Muhanga, Ruhango, Nyanza, Huye and Gisagara. Corresponding district hospitals and nearby health centers were selected for the study and one referral hospital in Huye. Participants were selected through hospital registers whereby researchers would verify daily to see the cases for preterm deliveries and the controls would be the next 2 on the register. It was unmatched case control but some few key variables like age, smoking habits and presence or absence of systemic conditions were considered for matching. The sample was calculated using G-Power 3.1.9.6. The researcher used small effect size of 0.06, alpha of 0.05 and power of 0.95 with 10 predictors. The G-Power calculation gave the sample size of 182.

A structured clinical exam and standardized questionnaire was used to collect information regarding the presence of periodontal infection and its association with preterm low birth weight among the pregnant women attending antenatal care clinics in the Southern Province of Rwanda. The study adapted into Rwandan context the questionnaire from WHO Oral health assessment tool for adults of 2013<sup>14</sup>. The questionnaire was sent to experts for content validation and it was piloted to ensure that it captures all variables as well as ensuring that the questions are clear to the respondents. The questionnaire was piloted in Nyamata district hospital in eastern province to ensure for cross culture validation and also to ensure that it captures all the information required and clarity of questions. After the pilot study, all the inputs from the participants were considered and questions that were not clear were corrected accordingly. The questionnaire was translated in Kinyarwanda using forward and backward translation whereby this questionnaire was translated in Kinyarwanda from English and it was again translated back to English by another translator to see if the meaning remains the same and the corrections were harmonized.

Questionnaire assessed the following variables: Age of the respondent, education level, health and lifestyle behavior like smoking, social economic category, mothers' weight, number of previous pregnancies, previous preterm or low birth weight and weight gain during pregnancy, illnesses during pregnancy and stress during pregnancy. "Ubudehe" categories in Rwanda are social classes put in place by Rwanda ministry of local government where by "*people in first category are very poor; do not have a house or cannot afford to pay rent, have a poor diet, cannot get basic household tools and clothes, the second category includes those who have their own houses, can afford to rent a house, mostly get food and earn a wage from with others, the third category includes those who have at least one person in the family working in the government or the private sector and the fourth category includes people who earn high incomes, people who own houses, people who can afford a luxurious lifestyle*"<sup>15</sup>.

A periodontal examination was also done on the study women. The trained and calibrated examiners used a periodontal to perform the periodontal clinical examination. The examiners were assessing

bleeding on probing, probing depth and clinical attachment loss measured in mm at six different sites on each tooth (buccal-mesial, mid-buccal, buccal-distal, lingual-mesial, mid-lingual and lingual-distal). The mothers in study group were asked about their dental care practices and their smoking habits. In addition, a full mouth periodontal screening was done by the researcher and calibrated dental therapists acting as research assistants. The mothers in study group were examined at their bedsides by the researcher and calibrated research assistants using a periodontal probe, intra oral mirror and headlights. A gentle probing force was applied to guide the tip into the periodontal pocket until the resistance was felt. The pocket depth was measured using cemento-enamel junction as a reference point. The current study defined periodontitis as presence of pocket depth greater than 3 mm on either maxilla or mandible or both and presence interdental clinical attachment loss (CAL) on either maxilla, mandible or both of 2 mm or above and buccal or oral CAL of 3 mm or above<sup>16</sup>. Clinical attachment loss was measured as follows: when the gingival margin was at the cemento-enamel junction and there was no recession, then the CAL was equal to the Pocket depth; when the gingival margin was apical to the cemento-enamel junction, CAL was equal to pocket depth + gingival recession; when the gingival margin was on the anatomical crown in case of gingival over growth, CAL was equal to pocket depth – gingival recession. CAL was not considered in some of the specific cases that were non-periodontal cause. For example, when gingival recession was of traumatic origin like in the case of poor brushing techniques, dental caries extending in the cervical area of the tooth and in the cases of recession by malposition of the tooth. Researcher and research assistants filled the questionnaires until the sample was reached.

Multivariate regression analysis was done and the variables were hierarchically grouped into three groups {the demographic variables of age and employment status were put first in the regression model as step 1, followed by the second group (regression model step 2) other potential factors of ever used tobacco, mothers' weight, last pregnancy, whether experienced premature delivery before, whether experiences stress before, malaria during pregnancy, urinary tract infection during pregnancy, physical trauma during pregnancy and violence during pregnancy. On the third step of regression model, the researcher put periodontitis as it was hypothesized as predictor variable.

## Results

There were 555 women in their post-partum period that were screened and all questionnaires were filled using structured interview until the sample was accumulated. The participants were from 6 districts of Southern province of Rwanda and from 12 health facilities. The participants were distributed with respect to age, education level, employment status, social economic status. The mean age was 27.35 (SD = 5.2) ranging from 18 to 35 years. Most participants (n = 338, 60.9%) were in the age range of 26–35 years, 47.6% had primary education, 38.7%, had secondary education, 7% had tertiary education and 6.7% had no formal education. The majority of the study participants, (n = 513, 92.4%) are from rural setting, 63.2% are farmers and 55.5% are in category 3 of "Ubudehe"/ social economic status as categorized in Rwanda national categories. Table 1

Table 1  
Demographic characteristics of participants

Variables		Frequency (n)	Percent (%)
<b>Age category</b>	16–25	217	39.1
	26–35	338	60.9
<b>Education level</b>	No formal education	37	6.7
	Primary	264	47.6
	Secondary	215	38.7
	Tertiary	39	7
<b>Residence</b>	Urban	42	7.6
	Rural	513	92.4
<b>Employment status</b>	Farmers	351	63.2
	Employed	71	12.8
	Students	32	5.8
	Not employed	101	18.2
<b>Economic status</b>	Category 1	56	10.1
	Category 2	191	34.4
	Category 3	308	55.5

### Factors associated with preterm low birth weight among pregnant women attending antenatal care clinics

To assess if there is a relationship between women who had periodontal diseases and those who had health gingiva in relation to preterm low birth weight, in our sample we had 370 women with normal gestation and normal birth weight babies (controls). On another group we had 185 (cases) women who had given birth prematurely and with low birth weight babies. Among the women with normal gestational age and normal weight babies, 229 (61.8%) had healthy periodontium while 141(38%) had periodontitis. On the other hand, among women with preterm low birth weight, 31 (16.7%) had healthy periodontium and 154 (83.2%) had periodontitis, chi-square test revealed that periodontal disease is significantly associated with preterm and low birth weight ( $\chi^2 = 100.902, p < 0.001$ ). There was also a significant association between preterm low birth weight and mothers' weight where by mothers with less weight were found to be with high chances of having periodontitis compared to those with normal weight ( $\chi^2 = 29.198, p < 0.001$ ), Last pregnancy was also found to be significantly associated with preterm low birth weight where by the mothers who got pregnant before 24 months after delivery were found to be with high risk of preterm low birth weight compared to those who got pregnancy 24 months and above after

previous delivery ( $\chi^2 = 19.474$ ,  $p < 0.001$ ), Women who had experienced premature deliveries before had higher chances of preterm low birth weight ( $\chi^2 = 47.989$ ,  $p < 0.001$ ), stress during pregnancy was also found to be associated with preterm low birth weight, where by the mothers who reported stress during pregnancy had high risk of preterm low birth weight compared to those who reported no stress ( $\chi^2 = 15.711$ ,  $p < 0.001$ ), some illnesses during pregnancy were also associated with preterm low birth weight like Malaria ( $\chi^2 = 5.686$ ,  $p = 0.021$ ), Urinary tract infection ( $\chi^2 = 5.382$ ,  $p = 0.020$ ). On the other hand, violence during pregnancy was also found to be significantly associated with preterm low birth weight ( $\chi^2 = 20.321$ ,  $p < 0.001$ ). Age, education level and residence are not associated with preterm low birth weight ( $\chi^2 = 0.639$ ,  $p = 0.2$ ), ( $\chi^2 = 5.862$ ,  $p = 0.1$ ), ( $\chi^2 = 1.855$ ,  $p = 0.2$ ) respectively. Chi-square test revealed association between tobacco and preterm low birth weight. Women who had ever used tobacco had high chances of having preterm low birth weight compared to those who had never used tobacco ( $\chi^2 = 4.630$ ,  $p < 0.04$ ). Table 2 **(Placed at the end of the text)**

Table 2  
Univariate analysis

<b>Variables</b>	<b>Sub-variables</b>	<b>Control/ Normal</b>	<b>Case/ PTLBW</b>	<b>χ<sup>2</sup></b>	<b>P- value</b>
<b>Age category</b>	17–25	149	68	0.639	0.2
	26–35	221	117		
<b>Education level</b>	No formal	23	14	5.864	0.1
	Primary	168	96		
	Secondary	147	68		
	Tertiary	32	7		
<b>Residence</b>	Urban	32	10	1.855	0.2
	Rural	338	175		
<b>Employment status</b>	Farmers	221	130	7.635	0.054
	Employed	56	15		
	Students	23	9		
	Not employed	70	31		
<b>Socio-Economic status</b>	Category 1	38	18	0.401	0.8
	Category 2	124	67		
	Category 3	208	100		
<b>Ever used tobacco</b>	No	368	180	4.63	0.04
	Yes	2	5		
<b>Recorded periodontal case</b>	Healthy	229	31	100.902	0.001
	Periodontitis	141	154		
<b>Mother's weight</b>	30–50	20	37	29.198	< 0.001
	51–75	332	143		
	76 & above	18	5		
<b>Last pregnancy</b>	12–24 Months	52	55	19.474	< 0.001
	Above 24 Months	318	130		
<b>ANC Visits</b>	No visits	0	1	5.015	0.08
	1–4 Visits	364	184		

Variables	Sub-variables	Control/ Normal	Case/ PTLBW	$\chi^2$	P- value
	5–8 Visits	6	0		
<b>Malaria during pregnancy</b>	Yes	78	56	5.686	0.021
	No	292	129		
<b>UTI during pregnancy</b>	Yes	32	28	5.382	0.02
	No	338	157		
<b>RTI during pregnancy</b>	Yes	5	6	2.272	0.193
	No	365	179		
<b>Other illnesses during pregnancy</b>	Yes	6	5	0.742	0.519
	No	364	180		
<b>Previous premature delivery</b>	Yes	3	28	47.989	< 0.001
	No	367	157		
<b>Stress during pregnancy</b>	Yes	57	55	15.711	< 0.001
	No	313	130		
<b>Physical trauma</b>	Yes	12	10	1.515	0.25
	No	358	175		
<b>Violence</b>	Yes	19	31	20.321	< 0.001
	No	351	154		
<b>Other causes of stress</b>	Yes	36	30	4.953	0.026
	No	334	155		

During bivariate analysis using chi square test, 11 variables namely; employment status, ever used tobacco, periodontitis, mothers' weight, last pregnancy, malaria during pregnancy, urinary tract infection during pregnancy, experienced premature delivery before, experienced stress during pregnancy and violence during pregnancy were associated with Preterm low birth weight therefore, eligible for multivariate logistic regression. Multivariate regression analysis was done and the variables were hierarchically grouped into three groups: where by demographic variable of employment status was put first in the regression model as step 1 and followed by other potential factors of ever used tobacco, mothers' weight, last pregnancy, whether experienced premature delivery before, where experiences stress before, Malaria during pregnancy, urinary tract infection during pregnancy, physical trauma during pregnancy and violence during pregnancy. On the third step of regression model, the researcher put periodontal diseases as it was hypothesized as predictor variable.

Employment status and ever used tobacco lost their significance after controlling for other variables ( $p = 0.4$ , 95% CI 0.3, 1.2), ( $P = 0.2$ , 95% CI 0.5,15.8) respectively but some other variables remained significant. After building the regression model, the results were as follows; the logistic regression revealed that mothers' weight was still significant after controlling for other variables, mothers with less weight had higher chances of giving birth to preterm and low birth weight babies compared to mother with normal weight where by the odds of giving birth to preterm low birth weight baby was 6 times for underweight compared to those with normal weight mothers ( $p = 0.002$ ) (95% CI 1 1.5, 27.9). Also the results from logistic regression revealed that women with history of giving birth to premature babies before, had higher chances of preterm low birth weight babies where by the odds of preterm low birth weight when you had ever experienced premature delivery was 14 times higher compared to those who had no history of premature deliveries ( $p < 0.001$ ) (95% CI 3.4, 45.9). It was also found out that women who had experienced violence during pregnancy had 6 times the odds of having preterm low birth weight compared to those who did not experience any violence during pregnancy ( $p = 0.007$ ) (95% CI 1.6, 20.0). Also interval between pregnancies was found to be associated with preterm low birth weight where by women who got pregnancy before 24 months after last delivery had 2 times odds of having preterm low birth weight compared to women who got pregnant 24 months above after previous delivery ( $p < 0.008$ ) (95% CI 1.2, 3.6). Finally, logistic regression revealed strong association between periodontitis and preterm low birth weight where by women who had periodontitis had 6 times the odds of giving birth to preterm low birth weight babies compared to women who had no periodontitis ( $p < 0.001$ ) (95% CI 3.9, 10.4). Table 3

Table 3  
Multivariate analysis of Preterm low birth weight and associated factors

<b>Variables</b>	<b>Categories</b>	<b>Wald</b>	<b>p-value</b>	<b>Odds</b>	<b>95% C.I</b>
<b>Employment status</b>	Farmers	2.9	0.403		
	Employed	1.6	0.203	0.7	0.3–1.2
	Students	1.9	0.169	0.6	0.2–1.3
	Not employed	1.5	0.218	0.5	0.1–1.6
<b>Ever used tobacco?</b>	No				
	Yes	1.4	0.233	2.8	0.5–15.8
<b>Mothers' weight</b>	30–50	12.9	0.002		
	51–75	6.3	0.012	6.4	1.5–27.9
	76 & above	1	0.299	2	0.5–7.7
<b>Had Malaria</b>	Yes	2.8	0.096	1.5	0.9–2.5
	No				
<b>Had UTI</b>	Yes	1.2	0.271	1.4	0.8–2.8
	No				
<b>Had RTI</b>	Yes	0.4	0.522	1.6	0.3–6.3
	No				
<b>Other illnesses</b>	Yes	0.09	0.761	0.7	0.1-5.0
	No				
<b>Previous premature delivery</b>	Yes	14.3	< 0.001	12.4	3.4–45.9
	No				
<b>Stress during pregnancy</b>	Yes	0.1	0.723	0.8	0.2-3.0
	No				
<b>Physical trauma</b>	Yes	0.9	0.332	0.5	0.1–1.9
	No				
<b>Violence</b>	Yes	7.2	0.007	5.6	1.6–20.0
	No				
<b>Other causes of stress</b>	Yes	0.5	0.457	1.6	0.4–6.2
	No				

Variables	Categories	Wald	p-value	Odds	95% C.I
Last pregnancy	12–24 Months	7	0.008	2.1	1.2–3.6
	Above months				
Periodontitis	Yes	58.3	< 0.001	6.5	3.9–10.4
	No				

## Discussion

Preterm birth is one of the major health care challenges and is associated with many potential consequences like lifelong disabilities and high health care costs<sup>3</sup>. Julie and Colleagues defined Pre-mature delivery as any delivery within a period of less than 37 weeks and these authors went ahead to say that almost 15 million neonates are born prematurely worldwide most especially in low and middle income countries<sup>17</sup>. Various risk factors were identified to be related to preterm low birth weight and these maternal risk factors include age, weight, socio economic status, smoking, multiple pregnancies, low prenatal care, nutrition, stress, genito- urinary tract infections and Malaria. Similarly, some studies have reported on the possible relationship between periodontitis and preterm low birth weight

Many studies have reported the association between maternal age and preterm birth; both extreme ages either lower age below 18 years or above 40 years are considered to be risk factors preterm low birth weight<sup>18, 19, 20, 21</sup>. Though majority of the studies found out that the older maternal age was associated with higher risk of preterm low birth weight. Ambrogio and colleagues in their study observed that both extreme ages that is, maternal age under 17 and advanced age over 40 were independent factor for preterm low birth weight (OR 2.97; 95% CI 1.24, 7.14, P < 0.005)<sup>18</sup>. This was echoed by Florent and co-authors who also found that both advanced age and lower age were risk factors for preterm low birth weight<sup>20</sup>. On the hand Mumghamba in Tanzania compared mothers who had PTLBW babies with and normal weight babies and found out that PLBW had a lower mean age<sup>22</sup>. Our study shows no association between maternal age and preterm low birth weight. In this study, most of the mothers were young whereby the mean age was 27.35 (SD 5.2) ranging from 18 to 35 years and may be the reason why there was no statistical association between maternal age and preterm low birth weight in this study. Similarly the study done in Uganda by Muwazi who also worked on a young population which led to low prevalence of periodontitis and later led to reduced statistical power and therefore no association was found<sup>23</sup>.

Maternal weight was also reported to be associated with preterm low birth weight where by in our study the logistic regression revealed that mothers with less weight had higher chances of pre-mature deliveries and low birth weight babies as opposed to mother with normal weight where by the odds of having preterm low birth weight baby was 6 times for underweight compared to those with normal weight mothers (p = 0.002) (95% CI 1.5, 27.9). Our study findings were echoed by Zhen and colleagues who

revealed that neonates born to underweight mothers had higher risk of preterm and low birth weight (95% CI 1.14, 1.25, RR 1.21) <sup>24</sup>. Many other variables were found to be associated with preterm low birth weight in this study were; interval between last pregnancy and the current, previous preterm birth, stress during pregnancy and illnesses during pregnancy. However, 25% of the cases was a proportion of preterm low birth weight of unknown etiology <sup>6</sup>.

In this study, the presence or absence of periodontitis disease was major predictor of pre-term delivery and low birth weight. After controlling for other variables logistic regression revealed strong association between periodontitis and preterm low birth weight where periodontitis could lead to six fold higher the risk of giving birth to preterm low birth weight babies compared to women who had no periodontitis ( $p < 0.001$ ) (95% CI 3.9, 10.4). Nevertheless, our study results are controversial to some other studies like the study done in Germany by Noack and colleagues who did not find any association between periodontitis and preterm low birth weight <sup>25</sup>. Similarly, Davenport in 2002 in his case control study did not detect any association between periodontitis and preterm low birth weight <sup>26</sup> and also Mumghamba in Tanzania in 2017 did not find any evidence to support periodontitis to be associated with preterm low birth weight <sup>22</sup>. However, our study is echoed by several other studies that supported the association between periodontitis and preterm low birth weight. Offenbacher et al., 1996 reported for the first time that there is a possible relationship between maternal periodontitis and delivery of a preterm infant where they reported that periodontitis during pregnancy could lead to seven times more risk of preterm birth <sup>6</sup>. In a systematic review by Teshome in 2016, he revealed the association between periodontitis and preterm low birth weight <sup>27</sup>. Lopez and colleagues also assessed the risk of preterm birth and low birth weight in women with periodontitis in the USA and found that pregnant women with periodontitis were at a higher risk of giving birth to premature babies with low birth weight ( $p = 0.0004$ ; RR = 3.5) <sup>28</sup>. Several other studies also confirmed the association <sup>9, 29, 10, 30, 31, 32</sup>. Also in Africa, some studies have been done on preterm birth and Low birth weight deliveries and these were significantly associated with poor periodontal status; for example a study done in Nigeria by Umoh and colleagues revealed that periodontal treatment was effective in preventing low birth weight deliveries <sup>13</sup>. In Uganda, Wandera and colleagues also found out that mothers having periodontal problems and poor oral hygiene during pregnancy had a greater risk of preterm low birth weight and opposed to mothers who had not periodontitis during pregnancy <sup>33</sup> and Muwazi in Uganda in his cross sectional study revealed the association between gingival recession and preterm birth <sup>23</sup>.

## Conclusion:

Periodontitis is a risk factor for preterm low birth weight and prevention solutions like having a periodontitis screening tool for nurses and midwives during antenatal care consultations are highly recommended.

## Abbreviations

**DHS**

Demographic health survey

**LBW**

low birth weight

**PTLBW**

Preterm low birth weight

**TNF- $\alpha$** 

Tumor necrosis factor- alpha

**IL-6**

Interleukin-6

**PD**

Pocket depth

**CAL**

Clinical attachment loss

**TSAM**

Training Support Access Model

**WHO**

World Health Organization

**SD**

Standard deviation

**CI**

Confidence Interval

## **Declarations**

### **Ethics approval and consent to participate:**

Permission to conduct the study was sought from the ethics committee of the University of Rwanda, College Medicine and Health Sciences and approval from study sites. Also permission from the Ministry of health to conduct study in the selected health facilities was sought and granted. Informed consent forms were given to the participants. Participants were informed that they have right to withdraw at any time and that their participation was be entirely voluntary. The participants were given the information sheet containing all the information about the study and those who did not know how to read, we read for them. After understanding the study benefits and risks and everything that was involved in the study, those who agreed were given the consent form to sign that they have voluntarily agreed to participate in the study. Information from the participants was be kept confidential and used for study purposes.

### **Consent for publication:**

This manuscript contains no any individual person's data in any form and consent for publication is not applicable for this section.

### **Availability of data and materials:**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### **Competing interests:**

All authors declared no competing interests.

## **Funding:**

Training Support Access Model (TSAM) project funded the study and it had no any other role in the design of the study, collection, analysis, interpretation of data or in writing the manuscript.

## **Authors' contributions:**

PU, CM, ST, AN and HS have made substantial contributions to conception and design, MK contributed in analysis and interpretation. All authors read and revised critically and approved the final manuscript.

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## **References**

1. Khadem N, Rahmani ME, Sanaei A, Afiat M. Association between preterm and low-birth weight with periodontal disease: a case-control study. *Iran J Reprod Med* [Internet]. 2012 Nov [cited 2016 Aug 27];10(6):561–6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25246927>.
2. Tielsch JM. Global Incidence of Preterm Birth. *Nestle Nutr Inst Workshop Ser* [Internet]. 2015 [cited 2018 Apr 12];81:9–15. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26111559>.
3. 10.3389/fpubh.2017.00066/full  
Newnham JP, Kemp MW, White SW, Arrese CA, Hart RJ, Keelan JA. Applying Precision Public Health to Prevent Preterm Birth. *Front Public Heal* [Internet]. 2017 Apr 4 [cited 2018 Jun 22];5:66. Available from: <http://journal.frontiersin.org/article/10.3389/fpubh.2017.00066/full>.
4. Survey H. Rwanda. 2014.

5. Heidi Worley. Population Reference Bureau [Internet]. [cited 2018 Jun 22]. Available from: <https://www.prb.org/rwanda-maternal-health/>.
6. 10.1902/jop.1996.67.10s.1103  
Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maynor G, et al. Periodontal Infection as a Possible Risk Factor for Preterm Low Birth Weight. *J Periodontol* [Internet]. 1996 Oct 28 [cited 2017 Oct 12];67(10 s):1103–13. Available from: <http://www.joponline.org/doi/10.1902/jop.1996.67.10s.1103>.
7. Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maynor G, et al. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol*. 1996;67(10 Suppl):1103–13.
8. Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maynor G, et al. Periodontal Infection as a Possible Risk Factor for Preterm Low Birth Weight. *J Periodontol*. 1996 Oct;67(10 s):1103–13.
9. Haerian-Ardakani A, Eslami Z, Rashidi-Meibodi F, Haerian A, Dallalnejad P, Shekari M, et al. Relationship between maternal periodontal disease and low birth weight babies. *Iran J Reprod Med* [Internet]. 2013 Aug [cited 2017 Aug 8];11(8):625–30. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24639799>.
10. Bansal M, Khatri M, Kumar A, Bhatia G. Relationship between maternal periodontal status and preterm low birth weight. *Rev Obstet Gynecol* [Internet]. 2013 [cited 2016 Aug 29];6(3–4):135–40. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24826203>.
11. Huck O, Tenenbaum H, Davideau J-L. Relationship between periodontal diseases and preterm birth: recent epidemiological and biological data. *J Pregnancy* [Internet]. 2011 Oct 30 [cited 2017 Oct 26];2011:164654. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22132334>.
12. Walia M, Saini N. Relationship between periodontal diseases and preterm birth: Recent epidemiological and biological data. *Int J Appl basic Med Res* [Internet]. 2015 [cited 2016 Aug 27];5(1):2–6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25664259>.
13. Umoh A, Ojehanon P, Savage K. Effect of maternal periodontal status on birth weight. *Eur J Gen Dent* [Internet]. 2013 [cited 2016 Aug 29];2(2):158. Available from: <http://www.ejgd.org/text.asp?2013/2/2/158/112318>.
14. Petersen PE, Ramon JB. Oral Health Questionnaire for Adults. *Oral Heal Surv Basic Methods* [Internet]. 2013;111–5. Available from: [http://apps.who.int/iris/bitstream/handle/10665/97035/9789241548649\\_eng.pdf?sequence=1](http://apps.who.int/iris/bitstream/handle/10665/97035/9789241548649_eng.pdf?sequence=1).
15. Nizeyimana P, Lee K-W, Sim S. A study on the classification of households in Rwanda based on factor scores. *J Korean Data Inf Sci Sociaty*. 2018;29(2):547–55.
16. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. 2018;89(January):159–72.
17. <http://www.ncbi.nlm.nih.gov/pubmed/27743648>.
18. 10.1186/s12884-019-2400-x  
Londero AP, Rossetti E, Pittini C, Cagnacci A, Driul L. Maternal age and the risk of adverse pregnancy outcomes: a retrospective cohort study. *BMC Pregnancy Childbirth* [Internet]. 2019 Dec 23 [cited 2020

- Jan 31];19(1):261. Available from:  
<https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2400-x>.
19. 10.1186/s12884-019-2183-0  
Soltani M, Tabatabaee HR, Saeidinejat S, Eslahi M, Yaghoobi H, Mazloumi E, et al. Assessing the risk factors before pregnancy of preterm births in Iran: a population-based case-control study. *BMC Pregnancy Childbirth* [Internet]. 2019 Dec 6 [cited 2020 Jan 31];19(1):57. Available from:  
<https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2183-0>.
  20. Fuchs F, Monet B, Ducruet T, Chaillet N, Audibert F. Effect of maternal age on the risk of preterm birth: A large cohort study. *PLoS One*. 2018 Jan 1;13(1).
  21. WAGURA PM. Prevalence and Factors Associated With Preterm Birth At. 2014.
  22. Mumghamba EGS, Manji KP. Maternal oral health status and preterm low birth weight at Muhimbili National Hospital, Tanzania: a case-control study. *BMC Oral Health* [Internet]. 2007 Jun 26 [cited 2017 May 27];7:8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17594498>.
  23. Muwazi L, Rwenyonyi CM, Nkamba M, Kutesa A, Kagawa M, Mugenyi G, et al. Periodontal conditions, low birth weight and preterm birth among postpartum mothers in two tertiary health facilities in Uganda. *BMC Oral Health* [Internet]. 2014 Apr 28 [cited 2018 Dec 6];14:42. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24773772>.
  24. Han Z, Mulla S, Beyene J, Liao G, McDonald SD. Maternal underweight and the risk of preterm birth and low birth weight: a systematic review and meta-analyses. 2011;(November 2010):65–101.
  25. <http://doi.wiley.com/10.1111/j.1600-0765.2005.00808.x>  
Noack B, Klingenberg J, Weigelt J, Hoffmann T. Periodontal status and preterm low birth weight: a case control study. *J Periodontal Res* [Internet]. 2005 Aug 1 [cited 2018 Apr 12];40(4):339–45. Available from: <http://doi.wiley.com/10.1111/j.1600-0765.2005.00808.x>.
  26. 10.1177/154405910208100505  
Davenport ES, Williams CECS, Sterne JAC, Murad S, Sivapathasundram V, Curtis MA. Maternal Periodontal Disease and Preterm Low Birthweight: Case-Control Study. *J Dent Res* [Internet]. 2002 May 13 [cited 2018 Apr 7];81(5):313–8. Available from:  
<http://journals.sagepub.com/doi/10.1177/154405910208100505>.
  27. Teshome A, Yitayeh A. Relationship between periodontal disease and preterm low birth weight: systematic review. *Pan Afr Med J* [Internet]. 2016 [cited 2018 Apr 12];24:215. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27800070>.
  28. 10.1177/002203450208100113  
López NJ, Smith PC, Gutierrez J. Higher Risk of Preterm Birth and Low Birth Weight in Women with Periodontal Disease. *J Dent Res* [Internet]. 2002 Jan 29 [cited 2017 Oct 12];81(1):58–63. Available from: <http://journals.sagepub.com/doi/10.1177/002203450208100113>.
  29. Marakoglu I, Gursoy UK, Marakoglu K, Cakmak H, Ataoglu T. Periodontitis as a risk factor for preterm low birth weight. *Yonsei Med J* [Internet]. 2008 Apr 30 [cited 2019 Feb 25];49(2):200–3. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18452254>.

30. Reza Karimi M, Hamissi JH, Naeini SR, Karimi M. The Relationship Between Maternal Periodontal Status of and Preterm and Low Birth Weight Infants in Iran: A Case Control Study. *Glob J Health Sci* [Internet]. 2015 Sep 28 [cited 2019 Feb 25];8(5):184–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26652090>.
31. 10.1007/s13224-016-0920-0  
Lohana MH, Suragimath G, Patange RP, Varma S, Zope SA. A Prospective Cohort Study to Assess and Correlate the Maternal Periodontal Status with Their Pregnancy Outcome. *J Obstet Gynecol India* [Internet]. 2017;67(1):27–32. Available from: <http://link.springer.com/10.1007/s13224-016-0920-0>.
32. Rakoto-Alson S, Tenenbaum H, Davideau J-L. Periodontal Diseases. Preterm Births, and Low Birth Weight: Findings From a Homogeneous Cohort of Women in Madagascar. *J Periodontol* [Internet]. 2010 Feb [cited 2018 Jun 23];81(2):205–13. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20151798>.
33. Wandera M, Astrøm AN, Okullo I, Tumwine JK. Determinants of periodontal health in pregnant women and association with infants' anthropometric status: a prospective cohort study from Eastern Uganda. *BMC Pregnancy Childbirth* [Internet]. 2012 [cited 2016 Aug 29];12:90. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22950749>.