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**Original article****Prevalence of Periodontitis and Associated Factors among Pregnant Women: A cross sectional survey in Southern Province, Rwanda**

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**Abstract****Background**

The literature has shown the relationship between maternal periodontitis and complications associated with pregnancy. Thus, prevalence estimates and risk factor identification for periodontitis during pregnancy in Rwanda are paramount.

**Aim**

The aim of the current study was to determine the prevalence of periodontitis and identify related risk factors among pregnant women in Rwanda.

**Methods**

A cross sectional study was conducted to determine the prevalence of periodontal diseases in a convenience sample of 400 pregnant women in the Southern Province of Rwanda. A logistic regression analysis using a hierarchical approach was performed to assess the risk factors for periodontal disease. Socio demographic factors were put in the regression model first followed by a second step for other potential factors.

## Results

The overall prevalence of periodontitis was 60.5%. Multivariable logistic regression showed that age OR=2.48 (95% CI. 1.18-5.22), education level OR=82.15 (95% CI. 8.21-822.11), socio economic status OR=2.28 (95% CI. 1.49-6.62), employment status OR=7.3 (95% CI. 1.38-38.74, and tobacco use OR=6.89 (95% CI. 1.78-60.65) were significantly associated with periodontitis.

## Conclusion

Periodontitis appears to be a common problem among pregnant women in Rwanda. Risk factor screening could help identify pregnant women at higher risk of periodontal disease.

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**Keywords:** Prevalence, periodontitis, risk factors, pregnancy, gingivitis

## Introduction

Periodontitis is a disease that can lead to inflammation and destruction of the supporting structures of the teeth.[1] This loss of attachment of periodontal ligaments is due to infection and inflammation of the gingival tissues.[2] Periodontal diseases are commonly caused by a dysbiosis in bacterial biofilm colonizing at and below the margin of the gingiva.[3] Periodontal diseases include the major categories of gingivitis and periodontitis whereby gingivitis refers to inflammation of gingiva without loss of supporting tissues while periodontitis involves attachment loss and bone loss.[2], Gingivitis is associated with poor oral hygiene and can be reversible with improved oral hygiene.[2] Gingivitis if not treated may be the precursor to periodontitis, resulting in destruction of periodontal ligament, bone and cementum.[2]

Periodontitis has been reported as the major cause of tooth loss in adults with periodontal destruction which is always irreversible.[4] Periodontitis has been reported to be the most common disease of mankind whereby severe periodontitis is the sixth most prevalent disease worldwide.[5] In the study done periodontal status among adults in South Africa, it revealed that the periodontal diseases were highly prevalent.[6] Periodontitis, as a chronic non-communicable disease (NCD), shares risk factors with other major NCD's that cause around two thirds of deaths, including heart disease, diabetes, cancer and chronic respiratory disease.[8] A study done on global prevalence of the periodontal diseases found widely varying levels of periodontal diseases; 60% in Norway, 30% in Iran, 15% in Belarus and 14% in Germany and Taiwan.[9]

The national health and nutrition survey that was done in 2009-2010 estimated prevalence rates in the U.S. population to be as high as 50%.[10] While in Latin America, the prevalence range of periodontal diseases was estimated to 40-80%.[11] The study done in India, reported the prevalence of periodontal diseases to be 85% of the general population and recommended the government as well as the dental council think of interventions in order to improve oral health and the quality of life.[12] In addition another study done in India found that 96.3% of the study population had periodontal diseases. [13]

In Africa, reported that periodontal diseases are quite high in many countries.[14] Also a study done in Mali on prevalence and predictors of periodontal diseases among pregnant women showed that the prevalence periodontal diseases was high.[15] In East Africa, a high prevalence of periodontal diseases was also reported in Kenya,[16] Uganda,[17] Tanzania,[18] and Rwanda.[19]

Periodontitis was found to be associated with preterm birth where by Offenbacher and colleagues in 1996 were the first to described this relationship between maternal periodontitis and premature delivery.[21] Since that time, there is

increasing evidence of an association between periodontitis and preterm birth.[23–26] Based on biological plausibility, it is believed that periodontitis can contribute to preterm birth through bacteremia where toxins and their products derived from maternal periodontitis can reach the bloodstream and cause injury to the placenta unit and to the amniotic fluid, leading to chorio-amniotic infections, thereby increasing the risk of preterm birth.[10] The dissemination of local inflammation throughout the body may also contribute to preterm low birth weight.[11]

### **The risk factors**

Studies have been done to identify the risk factors for periodontal diseases and they reported a variety of different factors.[27–29] These factors are either modifiable or non-modifiable. The modifiable risk factors include smoking, socioeconomic status, poor oral hygiene and pregnancy. The non-modifiable risk factors include age, gender and systemic diseases.[28] During pregnancy, there is an increased production of female hormones that are reported to cause gingivitis and periodontitis due to vascular permeability and tissue edema.[30] Pregnancy acts as a modifying factor of the pathogenesis of periodontal disease. Even if pregnancy itself does not cause

periodontal diseases, numerous studies have confirmed that pregnancy-related physiological changes increase gingival inflammation especially between the second and eight months of gestation resulting in pregnancy gingivitis. [30]

The identification of risk factors for periodontitis among pregnant women may facilitate early detection and treatment of periodontitis during pregnancy and thereby help to reduce its adverse effects on pregnancy, such as preterm low birth weight. Thus, the aim of the present study was to assess the prevalence of periodontitis and its associated risk factors among pregnant women in Rwanda.

## **Methods and Materials**

### **Study setting**

A cross sectional study assessed the prevalence and associated risk factors of periodontitis among pregnant women attending antenatal clinics in the Southern Province of Rwanda. The study was conducted in 6 districts of the Southern Province of Rwanda

Study population and sampling procedures

Pregnant women from 12 health facilities were selected. These health facilities were 6 district hospitals and their 6 respective health centers. Pregnant women who fulfilled the

inclusion criteria and signed the consent form were selected and screened for periodontitis during the two months of data collection from February – April 2018. The inclusion criteria were all the pregnant women who were present at the sites during the data collection period and who consented to participate in the study.

### **Sampling techniques and sample size**

The sample size was determined based on the formula by Singh & Masuku (2014) for calculating a representative sample for proportions in a large population [31] resulting in an estimated sample size of 384 participants. We added approximately 5% to the calculated sample size to adjust for the non-respondents or non-consents, therefore projected sample size was 400 pregnant women from the selected health facilities of Southern Province of Rwanda.

### **Data collection tool and procedures**

#### **Tool description**

A structured clinical exam and standardized questionnaire were used to collect information on the prevalence of periodontitis and associated factors among pregnant women attending antenatal care clinics in the Southern Province of Rwanda. The study adapted the WHO oral health questionnaire for

Adults of 2013.[32] It was a very generalized and detailed questionnaire but by adapting it, we only focused on questions related to the scope of our research and to our context. We left out the questions that were not relevant to our study. Since our study was on periodontal diseases, we added questions related to periodontology. Questions related to cariology, oral cancers and other general questions that are out of scope were removed. The questionnaire was sent to experts for content validation. The experts included two senior periodontists, one from University of Western Ontario and one from Harvard University and one senior statistician also from University of western Ontario. The periodontists gave their comments on the relevance of the questions in relation to the scope of the research, I addressed their comments and sent back the questionnaire and finally, they agreed on the content and relevance of the questions. The statistician also gave his comments on the questions and also shared his concerns on how different variables would be analysed and we finally agreed on the tool. After all the experts were happy about the content validity, the questionnaire was piloted.

The questionnaire was piloted in Nyamata District Hospital in the Eastern Province to ensure cross-cultural validation, and to ensure

that it captured 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 from English into Kinyarwanda using forward and backward translation whereby this questionnaire was translated into Kinyarwanda from English and it was again translated back to English by another translator to see if the meaning remains the same and any discrepancies were corrected prior to use in the study. The questionnaire assessed the following variables: age of the respondent, education level, health and lifestyle behavior (e.g. smoking), socio-economic status, employment status, oral hygiene behaviors like frequency of teeth cleaning, gum bleeding and dental visits.

### **Data collection procedures**

A periodontal examination was performed on all women enrolled in the study. The study examiners used a calibrated William's periodontal probe to perform the periodontal clinical examination. Six examiners were calibrated by a qualified dental therapist on how to perform a periodontal examination to see that they all understood it in the same way, to avoid having false results or different findings between the same

patients. The calibration process focused on probe design, gentle and constant force of probing and proper angulations. While no formal agreement analysis was conducted, the examiners were required to examine at least 2 patients and oral examination was conducted until all examiners were in agreement with each other and with the trainer. The calibration results were considered valid only when there was no discrepancy in results and when the results for 2 examiners were consistent with the lead researcher. The examiners assessed 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 the study group were asked about their dental care practices and their smoking habits. In addition, a full-mouth periodontal screening was done by the lead researcher with the calibrated dental therapists.

### **Measures**

The dependent variable, which was periodontitis (Yes or No) in our study, was defined as “presence of pocket depth greater than 3 mm on either maxilla or mandible or both and presence interdental of clinical attachment loss (CAL) on either maxilla, mandible or both of 2 or above and buccal or oral CAL of 3

mm or above. 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 deemed to be of non-periodontal cause. For example, when gingival recession was traumatic in origin, or in the cases 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”. [33]

### **Data analysis**

SPSS version 21.0 was used to analyze the study data. Descriptive statistics such as medians and the interquartile range were obtained, then univariate logistic regression analysis was conducted before main hypothesis testing analysis using multiple logistic regression. The study regression model was built using a hierarchical approach, where the demographic variables were entered first followed by the proposed risk factors. Odds ratios was calculated with 95% confidence

intervals and statistical significance was defined as  $p \leq 0.05$ .

### **Ethics consideration 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 the study in the selected health facilities was sought and granted. Informed consent forms were given to the participants. Participants were informed of their right to withdraw at any time and that their participation was entirely voluntary. The participants were given the information sheet containing all the information about the study and this was read to those who did not know how to read. After understanding the study's risks and benefits along with the details 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 kept confidential and used for study purposes.

## **Results**

### **Participants**

A total of 400 pregnant women were screened and the questionnaires were filled in using a structured interview until the full sample was accumulated. The participants were from 6 districts of Southern province of Rwanda and from 12 health facilities. Since the number of participants varied between health facilities, we used the population estimates from each health facility and we calculated the sample using proportionate sampling in order to have equal representation between health facilities. The numbers calculated from each health facility are as follows: (Remera Rukoma 70, Kabgayi 85, Kinazi 46, Nyanza 55, Kabutare 50, CHUB 60 and Kibirizi 34). The participants were varied with respect to age, education level, occupation, social economic categories/ wealth index. The median age was 29 years and the inter-quartile range was 9, 48.3% had at least attained primary education, 64.5% were farmers and 54.5% were from category 3 of social class. Of 400 participants (77.3%) had gingivitis and (60.5%) were diagnosed with periodontal diseases as shown Table 1

**Table 1. Demographic characteristics of respondents and predictor variable**

Variable		Frequency (n)	Percent (%)
Age category (Years)	16-25	98	24.5
	26-35	228	57
	36 Aged and Above	74	18.5
Education level	No formal education	22	5.5
	Primary	193	48.3
	Secondary	145	36.3
	Tertiary	40	10
Residence	Urban	100	25
	Rural	300	75
Employment status	Farmers	258	64.5
	Employed	82	20.5
	Students	22	5.5
	Not employed	38	9.5
Economic status	Category 1	50	12.5
	Category 2	132	33
	Category 3	218	54.5
Periodontal status	Healthy	158	39.5
	Periodontitis	242	60.5



### **Regression analysis results: Periodontitis with possible risk factors among pregnant women attending antenatal care clinics**

To assess if there is a relationship between periodontitis and some predicted risk factors, characteristics were compared initially in a univariate fashion. Results from the univariate regression analysis, suggest the presence of six possible risk factors, namely: age,

employment status, education level, residence, ever used tobacco, and socio-economic status. These variables were all associated with periodontitis status when examined on their own and were therefore eligible for the multivariable logistic regression analysis. Three variables namely: frequency of teeth cleaning, gum bleeding during brushing and dentist last visit were not significantly associated with periodontitis. Table 2

**Table 2. Association between periodontitis and potential risk factors**

Variable	Category	Periodontitis status			P-value
		Healthy n (%)	Periodontitis n (%)	Total n (%)	
<b>Age (Years)</b>					0.008
	17-25	46(46.94)	52 (53.06)	98(100)	
	26-35	94(41.23)	134(58.77)	228(100)	
	36 Aged and Above	18(24.32)	56(75.68)	74(100)	
<b>Education level</b>					<0.001
	Tertiary	33(82.5)	7(17.5)	40(100)	
	Secondary	68(46.9)	77(53.1)	145(100)	
	Primary	56(29.02)	137(70.98)	193(100)	
	No formal Education	1(4.55)	21(95.45)	22(100)	
<b>Residence</b>					<0.001
	Urban	58(58)	42(42)	100(100)	
	Rural	100(33.33)	200(66.67)	300(100)	
<b>Employment CAT</b>					<0.001
	Students	20(90.91)	2(9.09)	22(100)	
	Farmers	85(32.95)	173(67.05)	258(100)	
	Employed	37(45.12)	45(54.88)	82(100)	
	Not employed	16(42.11)	22(57.89)	38(100)	

<b>Economic status</b>	Category 3	96(44.04)	122(55.96)	218(100)	
	Category 2	52(39.39)	80(60.61)	132(100)	
	Category 1	10(20)	40(80)	50(100)	
<b>Ever used tobacco</b>					0.012
	Yes	1(7.14)	13(92.86)	14(100)	
	No	157(40.67)	229(59.33)	386(100)	
<b>Frequency of cleaning</b>					0.004
	Twice and three times a day	83(47.98)	90(52.02)	173(100)	
	Once a day	74(33.94)	144(66.06)	218(100)	
	Never	1(11.11)	8(88.89)	9(100)	
<b>Gum bleeding during cleaning</b>					0.264
	Yes	96(38.10)	156(61.9)	260(100)	
	No	62(43.88)	78(56.12)	140(100)	
<b>Dentist last visit</b>					0.7
	6 months or less	9(39.13)	14(60.87)	23(100)	
	More than 6 months	60(42.25)	82(57.75)	142(100)	
	Never	89(37.87)	146(62.13)	235(100)	

The multiple logistic regression analysis was then performed and the results suggest that there are statistically associations between periodontitis and age, employment status, education, residence, ever used tobacco and socio-economic status. Table 3

**Table 3. Multivariable logistic regression analysis of periodontitis with possible risk factors (Final model)**

<b>Variable</b>	<b>Category</b>	<b>Odds Ratio</b>	<b>P-value</b>	<b>95% Confidence Interval</b>
<b>Age (Years)</b>				
	17-25	1		
	26-35	1.95	0.016	1.13-3.36
	36 Aged and Above	2.48	0.017	1.18-5.22
<b>Education level</b>				
	Tertiary	1		
	Secondary	4.52	0.002	1.72-11.92
	Primary	9.34	p<0.001	3.22-27.15
	No formal Education	82.15	p<0.001	8.21-822.11
<b>Residence</b>				
	Urban	1		
	Rural	1.90	0.029	1.07-3.37
<b>Employment status</b>				
	Students	1		
	Farmers	3.58	0.121	0.72-17.88
	Employed	6.48	0.021	1.33-31.69
	Not employed	7.31	0.019	1.38-38.74
<b>Economic status</b>				
	Category 3	1		
	Category 2	0.81	0.405	0.49-1.34
	Category 1	2.28	0.049	1.00-5.16
<b>Ever used tobacco</b>				
	No	1		
	Yes	6.89	0.008	1.78-60.65

## Discussion

The current study found a high prevalence of periodontal diseases among pregnant women (60.5%). This study was in agreement with many other studies.[9-13] The multiple regression analysis tested the following as risk factors for periodontitis in the study population: age, education level, socio economic status, residence, employment status, tobacco use, frequency of cleaning, gum bleeding during brushing and time of brushing. The study findings indicate that older age, low education level, low socio-economic status and tobacco use were all statistically significantly associated with periodontitis, such that, for example, younger women have less chance of having periodontitis compared to the older women. This is in line with other studies that reported age to be associated with increased periodontal diseases.[10-12] The study done in Nigeria also reported the high level of attachment loss of 6mm and above which is a risk for further progression of periodontitis in elderly people of 70 years and above.[36] In addition, another study added that the increased susceptibility to periodontitis with age may be due to the continued exposure to inflammatory conditions and changes in the healing capacity and cells due to aging.[37] On the

other hand, another study have questioned the association between periodontitis and age and suggested that the association is due to cumulative instead of increased rate of destruction and concluded that age itself is not a risk factor for periodontitis and recommended for more advanced studies to control for other factors.[38] The current study found that the older ages had higher risk of having periodontitis and this may be due high level of attachment loss due to aging.

No formal education was also found to be significantly associated with periodontitis whereby the odds of having periodontitis with no formal education was 82 times higher, OR=82.15 (95% CI 8 .21, 822.11) compared to those that were educated. This was also reported by another study that revealed that patients with a lower degree of schooling had a greater chance of exhibiting periodontitis.[11] This may be due to the fact that lack of schooling may mean lack of awareness on oral hygiene practices like good oral hygiene, dentist visits, brushing habits and this may make them susceptible to periodontitis. Socioeconomically disadvantaged people in lower category were also found to be at high risk of periodontitis where class 1 category people had twice the odds of having periodontitis than those in the more socioeconomically advantaged

categories of class 3 and 4 OR=2.28 (95% CI 1.49, 6.62). This may be due to the fact that these women from lower classes are the ones who do not afford tooth paste and a tooth brush and are therefore susceptible to poor oral hygiene. This current study is in agreement with other studies that reported periodontitis to be associated with socio economic status. [8,29,39] All these studies report socio economic status to have a direct relation with worsening of the periodontal condition and are more frequent among people with lower socio economic status than those with high socio economic status and may be due to better oral hygiene and more frequent dental visits for those among the better educated class.[40]

The current study also revealed the association between tobacco use and periodontitis. People who had ever smoked were found to be at higher risk of periodontitis whereby the odds of having periodontitis when a woman had ever used tobacco was 6 times higher, OR=6.89 (95% CI 1.78-60.65) compared to those who had never used any tobacco products. This was also reported in a case control study by Bergstrom in Sweden with 155 periodontitis admitted patients. The study done on effect of tobacco on oral cancer also suggested that tobacco significantly aggravates the development and progression of periodontal disease

and oral cancer, and periodontal disease may be related to the prevalence of oral cancer.[41] In the USA, data from the National Health and Nutrition Examination Survey (NHANES III) showed that smokers were 4 times as likely as persons who never smoked to have periodontitis (OR=3.97) and that around 41.9% & 10.9% of periodontitis cases were attributed to current and former smokers respectively.[42] The study emphasized that former smokers were less likely to have periodontitis than current smokers but still more than those who never smoked.[42]

Finally, the logistic regression analysis in our study showed that frequency of cleaning and dentist last visit were not significant predictors of periodontitis. This means that differences in frequency of brushing and time of brushing may not be significant, not brushing at all was significantly associated with periodontitis meaning that oral hygiene is significantly associated with periodontitis. Similar to our findings , another study found that poor oral hygiene correlates well with gingivitis and that people who reported better oral hygiene also reported to have less gingivitis.[43]

### **Limitations**

The limitation for this study was the fact that it was done in one province of Rwanda and therefore the findings cannot be generalized to the whole

country. Secondly, some information was based on mothers' self-report and therefore social desirability bias could be an issue. Lastly, although calibration of research assistants was done, it was not formalized, therefore it is possible that there were still imprecisions of periodontal examination between examiners. However, as long as these differences in examination findings were randomly distributed across the examiners they would not likely affect the validity of the results, although they could impact the precision of the risk estimates.

## Conclusion

A high prevalence of periodontal diseases among pregnant women was reported for this study and the risk factors reported for periodontal diseases were age, social economic factors, education and use of tobacco. Therefore, oral health during pregnancy is quite important in order to reduce periodontitis which is suspected to cause adverse pregnancy outcomes.

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## Authors' contributions

All authors made a significant contribution to the work reported that is; conception, study design, execution, acquisition of data, analysis and interpretation

## Conflict of interest

All authors declared no conflict of interest and no competing financial interest.

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