

## Maternal Periodontal Disease and Adverse Pregnancy Outcomes at Muhimbili National Hospital, Tanzania: A Cross-Sectional Study

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Received: May 11, 2020; Published: May 28, 2020

### Abstract

**Background:** Periodontal disease (PD) is a multifactorial inflammatory condition in which inappropriate interactions between the host's immune response and specific groups of bacterial pathogens lead to destruction of connective and bone tissues supporting the teeth. Different studies conducted in developed countries have shown association between maternal periodontitis and adverse pregnancy outcomes such as prematurity and low birth weight infants, however, some other studies have not shown any association.

**Aim of the Study:** The aim of this study was to determine the relationship between periodontal diseases and birth weight and pre-term birth among postpartum women attending postnatal clinic at Muhimbili National Hospital.

**Methods:** A total of 400 postpartum women, aged 18 to 47 years were recruited for the study. The study involved collection of information on social-demographic characteristics, oral hygiene habits and behavioral factors using a self-administered structured questionnaire. Clinical periodontal examination of Ramfjord Index Teeth for assessment of periodontal status was performed. Chi-square of independence, p value < 0.05 and logistic regression were selected to test for associations.

**Results:** The mean age of study participants was  $28.5 \pm 6$  years. About 23% of postpartum women were found to have periodontal diseases. The most common clinical (intraoral) findings were plaque (59.5%), followed by gingival bleeding (42.5%) and calculus (35.5%). Periodontal disease was found in 26.9% (n = 45) and 20.2% (n = 47) of mothers with low and normal birthweight babies, respectively. Also, 23.3% (n = 41) and 22.8% (n = 51) of mother with periodontal disease had pre-term and full term babies, respectively.

**Conclusion:** This study showed that a significant number of post-delivery women suffered from periodontal disease mostly in the form of gingivitis but only a few had periodontitis. The study showed no statistical relationship between periodontal diseases and premature babies and low birth weight babies i.e. p value was not < 0.05. Similarly, no significant association between periodontal diseases and adverse pregnancy outcomes was observed. Regardless, frequent dental check-ups and oral health education should be incorporated in pre and post-natal health education sessions to prevent periodontal diseases.

**Keywords:** Low Birth Weight; Periodontal Diseases; Postpartum; Preterm; Tanzania

### Introduction

Periodontal disease (PD) is an inflammatory condition that is caused by an interaction between the host immune response and specific groups of bacterial pathogens [1-5]. Periodontal infections are postulated to lead to preterm birth and low birth weight through the

same mechanism as other maternal infections such as endometritis, uro-sepsis, septic abortion and the like by production of inflammatory mediators like prostaglandins, interleukins, interferons and lipopolysaccharide (LPS) [4,6,7]. These mediators are thought to lead to preterm/ premature birth with low birth weight.

Different studies including meta-analyses and systematic reviews conducted in developed countries have shown association between maternal periodontitis and adverse pregnancy outcomes such as prematurity and low birth weight infants [1,7-21]. However, some observational studies have not shown an association between periodontal diseases and preterm birth or low birth weight [18,22-28]. A few studies conducted in low/ middle income countries reveal a positive association between periodontal diseases and pre-term, low birth weight [24,25,27,29].

Furthermore, literature search shows a Tanzanian study that was conducted in 2007 revealed lack of any association between periodontal disease and preterm low birth weight [26]. The previous study was conducted more than 10 years ago and hence the conditions of living as well as the information acquired may have changed. This suggests that this topic may be controversial. Limited information is known about the association between periodontal diseases and adverse pregnancy outcomes in Tanzania specifically.

The scarcity of knowledge on this association may restrict designing of proper interventions aimed at controlling periodontal diseases among pregnant women and, impede efforts at reducing or alleviating adverse pregnancy outcomes including preterm, low birth weight among pregnant women in Tanzania, where resources to care for the pregnant women are scarce.

### Aim of the Study

The aim of this study was to determine the relationship between periodontal diseases and birth weight and preterm birth among postpartum women attending postnatal clinic at Muhimbili National Hospital.

### Methods

Study design, Study Area, Study population. This was a cross-sectional study conducted over a period of 4 months at the Postnatal Clinic in MNH, Dar-es salaam. MNH serves populations of different backgrounds, levels of education and socioeconomic status. It attends to referred patients from different regions and so serves a large number of diverse patients including those with different pregnancy outcomes. The study included all postpartum women who attended PNC at MNH Dar-es-Salaam and who were willing to participate during the time of the study.

### Sample size

A minimum of 350 participants was calculated using the proportion of postpartum women with periodontal diseases as 29.5% (Mumghamba and Manji., 2007), with the margin of error at 5%, 95% confidence interval and 10% increment to accommodate for non-respondents.

### Sampling procedure, inclusion and exclusion criteria

A consecutive sampling technique was used whereby all consenting postpartum women who had delivered within the previous 42 days (as recommended by the WHO) [22] and attended the PNC at MNH during the study period were considered for participation. Postpartum women who were mentally challenged and those with systemic conditions that interfered with the interview and clinical examination were not recruited to participate in the study.

### Data collection tools

A pretested self-administered questionnaire was used to assess social-demographic characteristics by recording age, level of education, residence, marital status, and oral health status. The questionnaire was constructed in English and translated to Kiswahili which is spoken by almost all (95%) Tanzanians.

One trained and calibrated dentist (CN) conducted all clinical examinations in the PMC, with an assistant recording the observations. The participants were seated on a chair with head rested looking upwards towards the ceiling. Periodontal examination was conducted using a Williams periodontal probe, mouth mirror and head-strapped light (Tolsen LED torch) under aseptic and sterile conditions on Ramfjord Index Teeth [23].

The clinical examination: Periodontal parameter measurements were collected on Ramfjord index teeth (16, 21, 24, 36, 41 and 44). If a Ramfjord tooth was missing, a substitute tooth was selected as suggested by Fleiss, *et al.* 1987 (teeth numbers 17, 11, 25, 37, 31, 45) [23]. The parameters measured included: Probing pocket depth measure in mm using CPI periodontal probe for all 6 surfaces of each index tooth and scored whereby; Score 0 meant  $\leq 3.5$  mm, Score 1 meant 3.6 - 5.5 mm and Score 2 meant  $> 5.6$  mm. Gingival recession scored in mm using William's periodontal probe. The value of gingival recession in mm. Clinical Attachment Loss (CAL): calculated from gingival recession and probing pocket depth measurements. Dental plaque, calculus and gingival bleeding on gentle probing: Score 0 meant absent and Score 1 meant present. NB: observations for gingival bleeding were recorded 15 seconds after gentle probing. Tooth mobility (According to Ramfjord's criteria): Score 0 meant physiologic mobility, firm tooth, Score 1 meant slightly increased mobility up to 1mm (G-I), score 2 meant definite to considerable increase in mobility ( $> 1$  mm) but with no impairment of function (G-II) and score 3 meant extreme mobility, horizontal mobility combined with vertical displacement and impairment of function (GIII).

Participants were said to have periodontal diseases (PD), when they exhibit the following: teeth showing at least one site (of the Ramfjord Index Teeth) with 4 mm of PPD and/or gingival recession and clinical attachment loss at the same site, were diagnosed as having periodontal disease (PD). Score 0 meant absence of PD and Score 1 meant presence of PD which meant that either one of the conditions or a combination of them were present (PPD, gingival recession and CAL). In order to get the value for PPD, each measurement was coded, summed up and recoded to 0 (no PD) and 1 (PD). Pregnancy outcomes is the final result of conception and ensuing pregnancy. The final results of interest for this study are: preterm birth (infants born alive, less than 37 weeks old) and low birth weight (infants weighing less than 2500g). Score 0 meant baby weighing  $> 2500$ g or baby born at full term ( $> 37$  weeks) and Score 1 meant baby weighing  $< 2500$ g (low birth weight) or baby born at preterm ( $< 37$  weeks).

### Data management

Quality checks were done at the end of each day to ensure that the information obtained was properly recorded. Double measurements at the site of data collection were done after ten patients to enable calculations for reliability. Data cleaning was done after entering data into the computer and frequency distribution tables were generated to identify outliers or missing entries.

Data analysis Independent (exposure) variables were socio-demographic characteristics - age, level of education, marital status and residency, while the dependent (outcome) variables were divided into primary and secondary outcomes. The primary outcome variable was periodontal diseases that included probing pocket depth, gingival recession, clinical attachment loss. The secondary outcome variable was pregnancy outcome (preterm birth, low birth weight).

Medical records of the participants were used to gather information on general health status and presence or absence of systemic conditions (BP, Hb level, Diabetes mellitus, Hypertension, Syphilis, HIV, TB, Malaria etc.) and prior pregnancies and outcomes (weight at birth, gestation age at birth and the patient's weight and height). Score 0 meant absence of systemic conditions and/or infections and Score 1 meant presence of systemic conditions and/or infections.

The data were analyzed using SPSS software for Windows version 20.0. Continuous and categorical data were assessed separately. The continuous data were summarized using means/ $\pm$  SD and categorical data were summarized using percentages. Bivariate associations were studied by using Pearson Chi square. A p-value of  $< 0.05$  was used as the level of statistical significance.

**Ethical issues**

Ethical clearance to carry out this study was requested from the MUHAS Research and Publications Committee and permission to conduct the study was sought from the Director of Research, Training and Consultancy of MNH. Participants were asked to sign a written informed consent. Data confidentiality was observed, coding error and missing information were retrieved before participants were discharged.

**Results**

Socio-demographic Characteristics of the study population From this study, the majority (81.5%) of the respondents were from Dar es Salaam and 18.5% were from other regions. The mean age of the participants was  $28.5 \pm 6$  years whereby many were young women (68.2%) and the majority were married/cohabiting (75.5%). Very few participants (3.3%) had no formal education and close to half of the study population (47.5%) had primary education. The remaining characteristics are shown in table 1. Among the characteristics, education status, diabetes, antibiotic use in the last two weeks and presence of systemic infection were regarded as confounders because they can affect periodontal diseases. Almost all the participants were not diabetic (98.2%), had no systemic infections (98.7%) and were not on any antibiotics (98.7%).

Characteristics	Frequency (n)	Percentage (%)
<b>Residence</b>		
Dare es Salaam	326	81.5
Other regions	74	18.5
<b>Age group (years)</b>		
16 - 30	237	68.2
> 30	127	31.8
<b>Level of education</b>		
No formal education	13	3.3
Primary education	190	47.5
Secondary education	133	33.2
Higher education	64	16.0
<b>Marital status</b>		
Single/ Divorced/Widow	98	24.5
Married/ cohabiting	302	75.5

**Table 1:** Socio-demographic characteristics of study participants (N = 400).

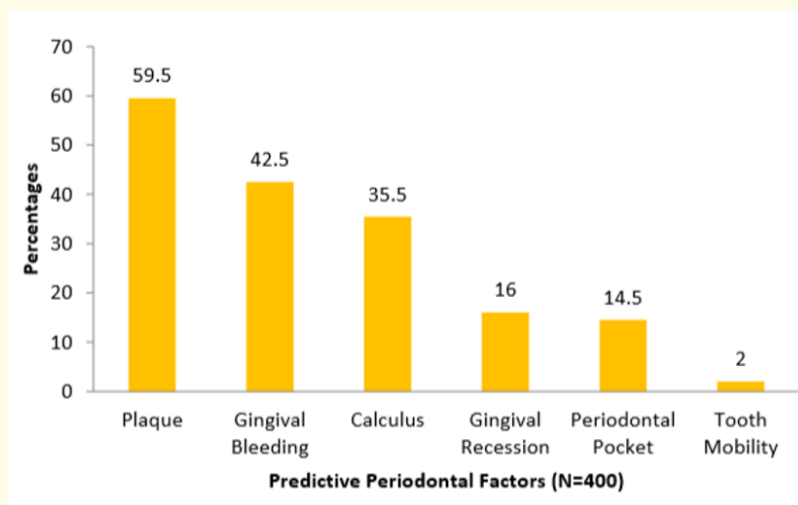
**Validity and reliability**

Prior to data collection, the research tools namely: questionnaire and clinical examination form were tested through a pilot study involving 10% subjects. Face and content validity-using expert opinion-during development of questionnaire was sought. The validity

of the instruments (Williams periodontal probe) for clinical data were probes that are used internationally and have been shown to be of acceptable validity [24]. The test retest reliability of the clinical examination was evaluated during the main data collection, whereby 10% of subjects were re-examined during the main study on two different occasions that were 10 days apart from each other. The mothers who were examined on the first 3 days were randomly selected and requested to revisit the PNC 10 days later for another checkup. Kappa scores were calculated to be 0.8 for plaque score, 0.77 for gingival inflammation and 0.82 for PPD. The paired data were analyzed to ascertain the degree of correlation for the continuous data. The reliability coefficient was calculated as  $r = 0.84$  for the current study.

**Periodontal diseases**

Among 400 postpartum women studied, 92 (23%) were found to have periodontal diseases. Figure 1 shows distribution of various predictive factors examined towards periodontal diseases among postpartum women. Plaque was the most prevalent predictive factor examined (59.5%, N = 238), followed by gingival bleeding (42.5%, N = 170). Periodontal pocket (depth of  $\geq 3.5$  mm) was 14.5% (N = 58).



**Figure 1:** Distribution of different forms of predictive periodontal factor among study participants (n = 400).

**Association between periodontal diseases and adverse pregnancy outcome**

Table 2 shows the association between periodontal diseases and adverse pregnancy outcomes. In this study, it was shown that there was no statistical relationship between periodontal diseases and premature babies and low weight babies (p value>0.05). Also, 41.5% had LBW and 44% had PTB.

Adverse pregnancy outcomes	Periodontal Diseases			p-value
	Yes	No	Total	
	n (%)	n (%)	n (%)	
<b>Birth weight</b>				
<2.5kg	45 (26.9)	122 (73.1)	167 (100)	0.143
$\geq 2.5$ kg	47 (20.2)	186 (79.8)	233 (100)	
<b>Time of delivery</b>				
< 37 weeks	41 (23.3)	135 (76.7)	176 (100)	0.996
$\geq 37$ weeks	51 (22.8)	173 (77.2)	224 (100)	

**Table 2:** Association between periodontal diseases and adverse pregnancy outcome (N = 400).

## Discussion

The socio-demographic variables show that the study participants came from various backgrounds, had different levels of education and were of various ages. The participants were well distributed and can be considered as a representative sample for the general population.

The aim of this study is to determine the relationship between periodontal diseases and birth weight and preterm birth among postpartum women attending postnatal clinic at Muhimbili National Hospital. This study shows no statistically significant association ( $p > 0.05$ ) between periodontal diseases and adverse pregnancy outcomes. While there are indications of an association between periodontal disease and increased risk of adverse pregnancy outcomes in some populations [8,9,13,14,25-27], there is no conclusive evidence that treating periodontal disease improves birth outcomes [18,24,36-39]. A study conducted in 2009 to compare postpartum periodontal treatment therapy with postpartum neonatal complications in women who were less than 37 weeks into gestation showed that there was no significant differences when comparing women in the treatment group with those in the control group with regard to the adverse event rate i.e. poor obstetric and neonatal outcomes [12]. This means that maternal periodontal disease may not be a risk factor associated with preterm low birth weight infants. In other words, low birth weight and preterm birth babies would occur equally whether or not the mother had periodontal diseases, and mothers would get healthy babies regardless of their periodontal diseases.

In contrast to this study, other studies have shown a positive correlation between periodontitis and PLBW [8,9,14,30-32]. For example, the study done by Lohana, *et al.* 2017 found a positive correlation between periodontitis and preterm birth low birth weight [34]. The differences in association in this case may be due to various reasons. This could be due to differences in defining the outcome (periodontal diseases), different methods employed, and different populations examined that could have overestimated the prevalence [26].

The findings of this study are different from another study done in USA that found an association between periodontal diseases and PTLBW [1]. This association could be because of the fact that other independent risk factors for PTLBW for instance hypertensive disorders of pregnancy were not controlled in the mentioned study.

Some of the limitations of the present study worthy of noting are: one; the nutritional status of the mother was not assessed because it was not within the scope of the present study and therefore its impact on this study is not known. Two; the diagnosis periodontal disease was based solely on clinical examination and was not confirmed with radiological examination nor was there any microbiological investigation for the presence of periodontal pathogens and hence this might have threatened the validity. Three; the study was performed on Ramfjord index teeth instead of full mouth periodontal examination, this may have over/underestimated the disease; however, we were optimistic based on an early report that identified Ramfjord index teeth as representative teeth in our setting [33].

## Conclusion

There is no association between periodontal diseases and adverse pregnant outcome. Although there is no association between periodontal diseases and adverse pregnancy outcomes, frequent dental check-ups and oral health education should be incorporated in pre and post -natal health education to prevent periodontal diseases and known systemic diseases complications.

## Ethics Approval and Consent to Participate

Ethical clearance to carry out this study was requested from the MUHAS Research and Publications Committee and permission to conduct the study was sought from the Director of Research, Training and Consultancy of MNH. Participants were asked to sign a written informed consent.

### **Consent for Publication**

Not applicable.

### **Availability of Data and Material**

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

### **Competing Interests**

The author(s) declare that they have no competing interests.

### **Funding**

The study was fully funded by the principal investigator.

### **Authors' Contributions**

CN: Principal investigator conceived and designed the study, conducted data collection, managed data, statistical analysis, organization and preparation of the manuscript.

BSL: Co-investigator participated in designing the study, supervised field organization and preparation of the manuscript.

IKM: Co-investigator participated in designing the study, and preparation of the manuscript.

Finally, all three authors, read, agreed to its contents and approved the final manuscript in its present form.

### **Acknowledgements**

We are grateful to Dr. Disha Bhatt for her assistance in clinical examination of the study participants and Mrs. Tita B Olirk for guidance in data analysis. We are very thankful to Prof. Gregory Czarnecki for all his support during the manuscript preparation. We appreciate cooperation given by the Heads, Department of Pediatrics and Child Health as well as Obstetrics and Gynecology, Muhimbili National Hospital. We are very much thankful to all mothers who gave consent and participated in this study and Colgate Ltd for providing toothbrush and toothpaste samples.

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**Volume 19 Issue 6 June 2020**

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