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Periodontal Disease of Pregnant Women and Low Weight Newborn in Senegal: A Case-Control Study

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Abstract

The aim of this work was to study the connection between periodontal diseas of women during their pregnancy and the weight of newborn infants the women gave birth to. Method: It was a case-control study and carried out on the outskirts of Dakar (Senegal). The sample consisted of 129 mothers with infants of weight < 2500 g (case) and 258 mothers with infants of weight ≥ 2500 g (control). The socio-demographic variables, patterns of life, history and outcome of pregnancy were collected. The variables relating to periodontal status included the plaque index, inflammation, bleeding, loss of clinical attachment and pocket depth. Data were analyzed by the R software. Logistic regression had identified associations on the threshold of 5%. Results: The proportions of mothers with periodontitis were 70.6% among cases versus 33% in controls. Periodontitis was significantly associated with low weight (OR = 4 [2.3 - 5.7] 4) adjusted on age, BMI and other periodontal indices. Conclusion: periodontal disease appears to be involved in the occurrence of low birth weight in the African context. The introduction of an oral component in prenatal consultations is therefore necessary for the health of mothers and their children.

Keywords

Periodontal Disease, Pregnant Women, Low Birth Weight, Senegal

1. Introduction

In Senegal, over the last 15 years, unlike the infant mortality rate juvenile who declined, the rate of neonatal

mortality has not registered a significant decrease. In fact, it went from 40‰ - 27‰ between 1990 and 2010 according to demographic and health surveys (DHS). This rate is even higher in rural than urban areas (42.9‰ versus 34.4‰) [1] [2]. As in all developing countries, the causes of neonatal mortality are mainly related to infections, low weight and/or prematurity among others. However, the low weight is very prevalent in Africa [3]-[6]. According to the EDS III [1] survey, 13.5% of women on average give birth to a newborn weighing less than 2500 g. The prevalence reported by Camara *et al.* [5] in Dakar was over 10%. Periodontal diseases, which are inflammatory and polymicrobial disorders are characterized by their magnitude and gravity. Epidemiological data in the world, have reported a prevalence of 80% for gingivitis and less than 30% for periodontitis [7]. Several risk factors have been implicated [4] [5]. However, Barnett *et al.* [8] found that 25% of low birth weight or premature occur without known risk factors. In Senegal, Sembene *et al.* in 2000 [6], found through a cross-sectional descriptive study that women with a need for periodontal treatment were more likely to have children of low weight without determining an association. The objective of this study was to investigate the association between periodontal disease in the mother and the baby's weight at birth.

2. Materials and Methods

2.1. Area and Type of Study

The Department of Guediawaye covers with which of Pikine, the most populous Senegal geographic territory with an average density of over 3600 people per square kilometer. The health center, which is our study area records 500 to 600 deliveries per month. The morbidity and mortality rate is 21‰. Given the frequency of low birth weight in this area, a so-called "Kangaroo" unit was established for the early management of these babies. The present case-control study was conducted at the health center Roi Baudouin of Guediawaye.

2.2. Study Population

The study population involved all new mothers who gave birth at the health center with their newborns.

2.3. Inclusion Criteria

The cases were made by mothers whose babies weight at birth <2500 g. Controls represented mothers with newborn birth weight ≥ 2500 g.

2.4. Exclusion Criteria

Mothers who had a gynecological infection during pregnancy or those giving birth to babies with a malformation or are stillborn and those giving birth twins were not taken into account. Mothers giving birth at home and came to the structure for secondary care or those whose health does not allow for an oral clinical examination were also not selected.

2.5. Recruitment Method

Cases were recruited sequentially according to their order of arrival. For the controls which were most common, they were drawn at the same time in the population of women in labor motherhood. Matching sex of the newborn was done. Thus for every male newborn from cases were matched two male newborns from controls women. Similarly, for each female newborn from case were matched two female newborns from controls.

2.6. Sample Size

The sample size was calculated using the Epi 2000. Considering a risk of 5% with a power of 80% with reference to the work of Diallo *et al.* [9], we made a theoretical exposure of 32% for periodontal disease controls. A 1.9% risk of delivering a low birth weight child when the mother has periodontitis was fixed arbitrarily. The final sample size was then 258 controls and 129 cases or 1 case for 2 controls.

2.7. Ethical Considerations

Before administering the questionnaire, we explained the purpose and importance of the survey to patients for

their consent; motivation and hygiene education were offered to them after the investigation.

2.8. Data Collection

Data were collected using a questionnaire. The questionnaire was pre-tested on 10 patients attending the maternity health post in the same neighborhood. The collection took place every day and involved all patients come to give birth at the maternity clinic and who met the selection criteria. It took place from February to May, 2010.

The information collected included: socio-demographic and biological characteristics: age, parity, body mass index (BMI), income, inbreeding; lifestyle: smoking, coffee, tea; medical history: anemia, hypertension, diabetes, malaria; data on pregnancy: mode of delivery, pre-eclampsia; periodontal data: periodontitis, plaque index, gingival index, papillary bleeding index, probing depth, attachment loss. Twenty-four hours after delivery, the mother was invited to an interview complemented by a clinical examination.

2.9. Exposure Measuring

It covered all the independent variables, which is the main, periodontitis was defined in any parturient with a loss of clinical attachment at least equal to 3 mm in at least 2 sites and a pocket depth ≥ 4 mm [10] [11]. A full review tray with a graduated periodontal probe was used to perform periodontal measures. This review was done by a student thesis year of dental surgery. He was previously standardized for these types of measures. Only the incisors and first molars, maxillary and mandibular were taken into account for the clinical examination. L'évaluation du niveau d'hygiène était faite par l'indice de plaque (PlI) de Silness et Löe (1964) [11]. The gingival condition was assessed by the gingival index (GI) of Löe (1967) [11]. The degree of bleeding was determined by the Saxer and Muhlemann papillary bleeding index (PBI) [11]. Periodontal probing for the determination of clinical attachment loss (CAP) and pocket depth (PD) measurements were performed with three labial measurements (mesiolabial, midlabial and distallabial) and three lingual or palatal ones.

2.10. Measure of Outcome or Dependent Variable

Measuring the outcome (birth weight) was with a baby scale. This balance was brand Kern MBE 10K10 version 1.0. The measurements were made by the mistress midwife.

2.11. Strategy for Data Analysis

Data entry was performed with Epi 2000 software version 5.3.1. Univariate analysis provided the proportions and the mean or median of the variables studied. Certain variables were redefined in dichotomized yes and no. Associations between variables were examined by the chi2 test or its variants (Fisher and Yates) and their strengths were determined by odds ratios with confidence intervals. Modeling with backward manual procedure (backward selection) was developed with variables whose p was less than 0.25 in bivariate analysis between an independent variable and the dependent variable. At each step, the variable associated with the largest p-value was removed from the model at 5%. The procedure is stopped when all of the remaining variables in the model all had a p-value less than the threshold with the exception of those forced (periodontitis, age and BMI). To control the confusion, we checked at each output variable, the change in odds ratio of the primary independent variable "periodontitis" by calculating the relative change. Interactions with the variable "periodontitis" were tested. The R version 2.9.0 software was used. This analysis strategy was used to identify independent variables significantly associated with the dependent variable (low weight). The results were marginally significant when close to 5% and significant p where p was less than 5%. In the subsample of mothers giving low infant birth weight, three have not had a periodontal clinical examination for health reasons. For the controls, there were six for the same reasons. These mothers have not participated to the study and finally, the size was 126 cases versus 252 controls.

3. Results

3.1. Description of Socio-Demographic and Biological Characteristics, Lifestyle, Medical History and Pregnancy Outcome

Table 1 shows that the "age", "BMI" and "vaginal delivery" were significantly associated with low infant

Table 1. Odds ratios of the various characteristics of mothers associated with low infant birth weight by simple logistic regression.

Characteristics (units)	Modalities	Case n = 126	Controls n' = 252	OR	IC 95%	P-value
Socio-demographic and biological characteristics of mothers						
Age of mother (year)		126	252	1.68	[1.14 - 2.01]	0.046
Parity	-	126	252	0.86	[0.72 - 1.03]	0.11
BMI (Kg/m²)		126	252	2.05	[1.29 - 2.74]	0.01
Income (FCFA)	≥100000	21	36	1.2	[0.64 - 2.24]	0.54
	<100000	105	216	1	-	-
inbreeding	Yes	12 (9.5%)	17 (6.7%)	1.46	[0.63 - 3.34]	0.33
	No	114	235			
Lifestyle of mothers						
Active tobacco	Yes	3 (0.2%)	4 (1.5%)	1.51	[0.26 - 8.13]	0.59
	No	123	248	1	-	-
Passive smoking	Yes	17 (13%)	31 (12%)	1.51	[0.56 - 2.19]	0.74
	No	108	219	1	-	-
Coffee	Yes	38 (30%)	77 (30%)	0.88	[0.60 - 1.60]	0.94
	No	88	175	1	-	-
Tea	Yes	63 (49%)	115 (45%)	1.19	[0.76 - 1.87]	0.42
	No	63	137	1	-	-
Medical history						
Anemia	Yes	65 (52%)	115 (5.6%)	1.27	[0.81 - 1.99]	0.27
	No	61	137	1	-	-
Diabetes	Yes	12 (9.5%)	14 (5.5%)	1.77	[0.74 - 4.23]	0.16
	No	114	236	1	-	-
Hypertension	Yes	28 (22%)	36 (14.2%)	1.71	[0.96 - 3.07]	0.052
	No	98	216	1	-	-
Malaria	Yes	49 (39%)	83 (33%)	1.29	[0.81 - 2.06]	0.26
	No	77	168	1	-	-
Pregnancy outcome						
Mode of delivery	Vaginal	89 (71%)	151	1.61	[0.99 - 2.61]	0.042
	Cesarean	37	101	1	-	-
Pre-eclampsia	Yes	6 (4.7%)	3 (1.2%)	4.45	[0.90 - 21.3]	0.07
	No	120	250			

[*]655.957 = 1€

birth weight in bivariate analysis.

3.2. Description of Periodontal Characteristics

Table 2 describes the associations between periodontal characteristics of the mother and baby low birth weight in simple logistic regression. All these characteristics were associated with baby low birth weight.

Table 3 presents the final model retained after multivariate analysis using the manual procedure down. It showed that periodontitis in mothers was significantly associated with baby low birth weight (OR = 4.4 [2.3 to 5.7]) adjusted for age, BMI and other variables. The age of the mother and plaque index were marginally associated with baby low birth weight (p = 0.05 and 0.053) while BMI, gingival index and papillary bleeding were

Table 2. Odds ratios of periodontal characteristics of mothers associated with baby low birth weight by simple logistic regression.

Periodontal characteristics (units)	Modalities	Case N = 126	Controls N = 252	OR	CI	p-value
Periodontitis	Yes	89 (70%)	83 (33%)	4.9	[3.1 - 7.8]	<0.001
	No	37	169	1	-	-
Plaque index		126	252	2.016	[1.01 - 3.02]	0.047
Gingival index		126	252	3.022	[1.18 - 4.03]	0.026
Bleeding index		126	252	4.019	[2.01 - 6.02]	<0.001
Attachment loss (mm)		126	252	2.1	[1.1 - 3.7]	0.044
Pocket depth (mm)		126	252	2.045	[1.35 - 4.55]	0.049

Table 3. Odds ratio of the mothers characteristics associated with baby low birth weight in multivariate regression hand down.

Characteristics modalities		OR	CI 95%	P-value
Periodontitis	Yes	4.45	[2.3 - 5.7]	0.00013
	No	1	-	-
Age of mother		1.62	[0.99 - 2.02]	0.05
BMI		2.03	[1.21 - 3.05]	0.03
Plaque index		1.89	[0.99 - 2.01]	0.053
Gingival index		2.015	[1.11 - 3.022]	0.026
Bleeding index		3.1	[2.04 - 6.05]	0.015
Attachment loss (mm)		2.21	[1.62 - 4.04]	0.045
Pocket depth (mm)		2.25	[1.23 - 3.7]	0.041

significantly associated with baby low birth weight (OR = 2.03 [1.21, 3.05] 2.015 [1.11 to 3.022], 3.1 [2.04 to 6.05]).

In addition, the terms of assumed interaction (periodontitis × age × active periodontitis tobacco × Passive smoking periodontitis) tested were not significant with p = 0.89; p = 0.56 and p = 0.81.

4. Discussion

This work allowed us to study the association between periodontal status of the mother and baby low birth weight. The risk of having a baby low birth weight was 4.45 times higher if the mother had periodontitis with adjustment for age, BMI and other periodontal index.

4.1. Limitations of the Study

In calculating the sample size, the choice with reference to the data in the study of Diallo *et al.* [9], could affect our results because they had not found the prevalence among pregnant women but in the general population. To minimize bias and increase the validity of our results, it was necessary to control for confounding factors known to the baby low birth weight. In addition mothers with gynecological disorder or an infection other than periodontal were not included in the study. However, to reduce residual confounding in the analysis, we adjusted for other factors that are socio-demographic, biological, lifestyle or medical history. When collecting data only one person conducted blind measurement of exposure. As to the outcome or result, it was collected by the midwife and for this, to minimize non-differential misclassification.

4.2. Socio-Demographic and Biological Characteristics

The age of the mother include young age (<18 years) may influence the intrauterine growth of the fetus [12]. In our study the average age of cases mothers was lower than that of controls. This age was significantly related to

baby low birth weight (**Table 1**). However, this association remained marginal after adjustment for BMI and periodontal characteristics (**Table 3**). In this study, mothers of low birth weight babies had an average BMI of 25.9 ± 7.11 (**Table 1**). BMI was significantly related to low birth weight baby, even after adjusting for age and periodontal characteristics (**Table 3**). The case-control study by Ndiaye *et al.* in 2006 [4] in Senegal did not demonstrate a relationship between BMI and low weight. Parity was not related to infant low birth weight unlike retrospective study of Bobossi-Seringbe [13] in Centrafrique found a statistically significant association (p = 0.01). This association could be explained by the lack of adjustment for factors that were not collected due to the retrospective nature of the study. Regarding income couples, it was usually less than 100,000 fcfa (152.4 €) per month (**Table 1**). This is reinforced by the living conditions in the suburbs of Dakar where poverty is relatively common [1]. Our results did not show statistically significant link between income and low baby weight (**Table 1**) in contrast to those of Camara *et al.* [5].

4.3. Lifestyle of Mothers

In our study, neither passive nor active tobacco smoking were significantly associated with low birth weight baby. These results are similar to those of Ndiaye *et al.* [4].

The consumption of coffee and tea were not significantly associated with infant low birth weight (**Table 1**). Bichalo *et al.* [14] in a case-control study of 354 infants of less than 2500 g weight and 354 others over 3000 g showed a lack of statistically significant link between regular tea consumption and the delay of expected growth for a low birth weight baby.

4.4. Medical History and Pregnancy Outcome

Anemia was more frequent among cases (**Table 1**). However, there was no significant association between maternal anemia and infant low birth weight. It was the same for malaria and diabetes (**Table 1**) whose gestational concerns to 1% - 4% of pregnancies according to Reece *et al.* [15]. The link between hypertension and low weight birth baby was marginally significant (p = 0.05) (**Table 1**). This pressure, if it is associated with proteinemiaover than 300 mg/day causes preeclampsia formerly called toxemia of pregnancy. Williams *et al.* [12] in their analysis of the mechanisms of risk of low birth weight baby and /or premature retain these factors as essential. Kramer [16] also ranked among the determinants of the baby's low weight in a meta-analysis study.

4.5. Periodontal Characteristics

The effectiveness of plaque control was lower especially in cases (**Table 2**). However, a qualitative interpretation of the plaque index showed that oral hygiene was deficient in women. The lack of hygiene is probably due to poor brushing technique. Our results showed that the plaque index was significantly related to low birth weight baby in bivariate analysis (**Table 2**) and that this association was marginal after adjustment for age, BMI and other periodontal characteristics (**Table 3**). Khader *et al.* [17] found in that a very significant association relationship (p < 0.001). Inflammations as well as gingival bleeding were lower in controls than in cases (**Table 2**); the association remained statistically significant even after adjustment for age, BMI and other periodontal characteristics (**Table 3**). Marin *et al.* [18] in Brazil on a cross-sectional study of 162 volunteers on the correlation between the child's weight at birth and periodontal status considering only continuous variables, showed that the baby's weight at birth decreased when periodontal status (inflammation and spontaneous bleeding) was more affected (negative correlation). Spontaneous gingival bleeding cannot be responsible for the baby low weight but could be a warning sign or symptom of anemia which would lead the specialist to take adequate preventive measures. However, the presence of a microbial plaque is responsible for inflammation and bleeding factor; this could also encourage reflecting on bacterial translocation [12]. Offenbacher *et al.* [19] described a series of inflammatory mediators (PGE2, TNF...) involved in the induction of labor to give birth and in greater concentration in an active phase of periodontal disease. However, a case-control study by Isaac *et al.* [20] in Brazil concluded by a lack of significant association between low birth weight baby and the presence of inflammation and spontaneous bleeding in the mother. The clinical attachment loss and probing pocket depth not averaged 3 mm both in cases than in controls (**Table 2**). A comprehensive interpretation of their values does not criminalize the periodontal status in relation to the birth of low weight baby. However, a significant association was obtained after adjustment for age, BMI and other periodontal characteristics (**Table 3**). Loss of clinical attachment cha-

racterizes periodontal bone lesion level and is used for the clinical diagnosis of this lesion. Yet these two variables do not interact with periodontitis. It was found that over 70% of women giving birth to low weight babies had periodontitis versus 33% for controls (**Table 2**). These periodontitis allow colonization of the genitourinary tract by gram-negative bacteria. This could cause an immune response after the action of bacterial lipopolysaccharide and the release of pro-inflammatory citokynes [19] which, in turn, can contribute to low birth weight baby or premature birth. The observed association between periodontitis and low birth weight baby was highly significant (OR = 4.45; [2.3 to 5.7]) (**Table 3**). So the risk of giving birth to a child of low weight was 4.45 times higher when the mother was developing periodontitis. However Buduneli al [21] in Turkey, through case-control study did not reveal any significant relationship between periodontal infections and infant low birth weight and/or prematurity. This lack of relationship may be due to uncontrolled confounding.

5. Conclusion

Periodontal disease is associated with the occurrence of low birth weight in the African and Senegalese context. Other etiologic longitudinal studies are needed that highlight the relationship between periodontal disease and low birth weight in black subjects. It is equally important to educate physicians, and more particularly the gynaecologists or midwives, on the need to integrate examination of oral conditions in their consultations.

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