ORIGINAL ARTICLE
ASSOCIATION OF MATERNAL PERIODONTITIS WITH LOW BIRTH WEIGHT IN NEWBORNS IN A TERTIARY CARE HOSPITAL

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Background: Low birth weight is a major public health problem in Pakistan. So there is a need for identification of its modifiable risk factors like periodontitis which will reduce its burden on the society. The objectives of the study were to find out the association between maternal periodontitis and low birth weight in new-borns of all gestational ages delivered in a tertiary care hospital of Abbottabad as well as to see the frequency of periodontitis severity in these subjects. **Methods:** A hospital-based matched case-control study was conducted among 160 postpartum mothers in Gynaecology/Obstetrics-B ward Ayub Teaching Hospital, Abbottabad. The 80 cases were mothers of low birth weight babies (<2,500 g), the 80 controls were mothers of normal weight babies (≥2,500 g) matched with maternal age and gestational age. Data was collected through the hospital records, interview and a periodontal examination. **Results:** Periodontitis was more in the cases than in the controls (OR: 4.167, 95% CI: 2.142–8.109, p=0.000). On multivariate logistic regression, periodontitis was found to be a significant independent risk factor for low birth weight (aOR: 3.173, 95% CI: 1.429–7.047, p=0.005). Other significant risk factors were educational level (aOR: 3.408, 95% CI: 1.452–7.996, p=0.005), socioeconomic status (aOR: 3.173, 95% CI: 1.366-7.368, p=0.007), maternal nutrition (aOR: 3.071, 95% CI: 1.392-6.778, p=0.005) and moderate/severe anaemia (aOR: 3.035, 95% CI: 1.052–8.756, p=0.040). **Conclusions:** Periodontitis is found to be a strong, independent, and clinically significant risk factor for low birth weight. So periodontal therapy should form a part of the antenatal care of the pregnant women in Abbottabad.
Keywords: Low birth weight infant, Periodontitis, Risk Factors

INTRODUCTION

Low Birth Weight (LBW) is a prevalent public health problem in the world and especially in the developing countries but can be prevented.[1] The World Health Organization (WHO) defines LBW as "birth weight less than 2500 grams or 5.5 pounds".[2] Worldwide incidence of LBW is about 16 percent[3] and in Pakistan, it is approximately 32 percent[4]. LBW plays a significant role in neonatal, infant and childhood mortality and morbidity and later these infants have increased chances of developing cardiovascular diseases and other non-communicable diseases.[5] LBW occurs either due to babies being preterm and/or being small for gestational age with intrauterine growth retardation or without it (constitutionally small).[1,6] It is one of the adverse pregnancy outcomes (APOs) which are costly to manage by health care.[7] LBW may be caused by foetal, maternal or placental factors or a combination, which leads to compromised placental transport of nutrients or decreased growth potential of the foetus.[8] The risk factors are high and low maternal age, ethnicity, single marital status, multi-parity, short

birth intervals, level of education and low socioeconomic status, genetic aberrations, chronic hypertension, diabetes mellitus, renal diseases, hypertensive disorders of pregnancy, gestational diabetes, malnutrition, vaginal bleeding, moderate and severe anaemia, Müllerian anomalies, twin gestations[6,9], tobacco use, alcohol, drug abuse, inadequate antenatal care, heavy physical activity, previous history of abortion or LBW and genitourinary infections[6]. But the mechanisms causing LBW are not known in around 40 percent of cases.[10]

Periodontitis is defined as "an infectious disease resulting in inflammation within the supporting tissues of the teeth, progressive attachment and bone loss and is characterized by pocket formation and/or recession of the gingiva".[11] Periodontitis occurs in 5–20 percent of pregnant mothers.[12] It is the commonest dental disease in Pakistan and 22 percent of females suffer from bleeding gums.[13]

It is hypothesized that remote infections like periodontal diseases may have an association with LBW through related mechanisms as found with

other maternal infections. Studies carried out in a variety of population groups over the years have given solid evidence that maternal periodontal disease is an independent risk factor for LBW. Whereas some studies failed to find an association.[14–18] Maternal periodontal disease as a risk factor for LBW is more or less an uncharted territory and whether the association is causal or not is still undecided. So far probably no study has been done in Pakistan which focuses only on low birth weight and maternal periodontitis.

The aim of this study is to investigate the association between maternal periodontitis as an independent risk factor for LBW in new-borns in a tertiary care hospital. If the hypothesis that there is a positive association between maternal periodontitis and LBW in new-borns is proven, then it will be a vital finding since being a modifiable risk factor its prevention and control in a population can be properly carried out.[9] In addition, it has been shown that pregnant females undergoing periodontal treatment had fewer LBW babies.[19] Moreover, periodontal treatment in pregnancy is recommended by the "American Academy of Periodontology" as well as the "American College of Obstetricians and Gynaecologists".[20,21] The study was conducted with the objectives to find out the association between maternal periodontitis and low birth weight in preterm (less than 37 weeks of gestation), term (37 weeks to less than 42 weeks of gestation) and post-term (42 weeks and above of gestation) new-borns delivered in a tertiary care hospital and to see the distribution of the severity of periodontitis in the study subjects.

MATERIAL AND METHODS

A matched case-control study was carried out from January to July 2015 in Gynae B Ward, Ayub Teaching Hospital, Abbottabad. The study population was postpartum, primiparous, 18–35 years old, married mothers fulfilling the inclusion criteria reporting to the Gynae and Obstetric labour room and ward matched by maternal age and gestational age. Case Control Ratio was 1:1. Sample size was calculated with the help of Epi Info Version 7[22] as 160 with 80 cases and 80 controls. It was calculated with two-sided confidence level 95 percent, power of 90 percent, Odd's ratio of 2.94, the percentage of cases exposed as 52.94 percent and the percentage of controls exposed as 27.64 percent.[9] Sampling technique was non-probability purposive sampling. Cases were mothers who have given birth to LBW babies weighing <2,500 grams (preterm, term and post-term) taken from the hospital according to the birth weight percentiles by gestational age chart.[23]

Controls were mothers who have given birth to normal birth weight (NBW) babies weighing ≥2,500 grams (preterm, term and post-term) matched with maternal age and gestational age according to the birth weight percentiles by gestational age chart.[23] These mothers were delivered within the first 48 hours of the examination both by caesarean section and vaginal delivery. Inclusion criteria included primi-parous mothers belonging to the age group of 18–35 years with singleton pregnancy and having at least twenty teeth. Exclusion criteria included multiparous women, those suffering from a known chronic systemic disease known to affect LBW, hypertensive disorders of pregnancy, gestational diabetes, and genitourinary infections, history of antepartum haemorrhage, mothers with stillborn birth and having periodontal therapy during pregnancy.

Ethical approval was obtained from the ethical committee of Ayub Medical College. Informed written consent was taken from the study subjects. Data was collected on a regular basis from Gynae B ward and the labour room with the help of pretested structured questionnaire through interview and patient medical records. History and patient medical records was verified by the doctor on duty. Babies were weighed with the Mechanical baby scale SH 8017 (Uhong). Periodontitis was assessed by a trained dentist who performed full-mouth clinical periodontal examination to check the periodontal parameters with the help of the University of Michigan 'O' Probe with Williams markings periodontal probe.

Demographical and socioeconomic details were inquired from the subject. Socioeconomic status was determined by taking into account education, occupation and family income per month using the Modified Kuppuswamy socioeconomic status scale.[24] Subjects were asked about the intake of tobacco and the number of antenatal visits. Presence of heavy physical activity during pregnancy was assessed by inquiring about doing occupational work, work at home and presence or absence of servants and relatives. Gestational age was calculated from the last menstrual period and verified with ultrasound.[11] Maternal nutritional status was assessed by measuring the mid-upper arm circumference (MUAC) with a measuring tape because it is a better indicator of maternal nutrition than Body Mass Index (BMI) as it unlike BMI remains somewhat unchanged during pregnancy.[25] Haemoglobin (Hb) in g/dl was noted from the medical records. Presence of anaemia was assessed through it by using the WHO criteria where Hb

level of below 10 g/dl is classified as moderate anaemia and below 7 g/dl as severe anaemia.[26]

Periodontal parameters were periodontal probing depth (PPD) measured as the depth of the periodontal pocket measured in mm from the free gingival margin to the bottom of the gingival sulcus/periodontal pocket, clinical attachment level (CAL) measured as the distance measured in mm from the cemento-enamel junction to the base of the gingival sulcus/pocket and bleeding on probing (BOP) which is determined to be positive if bleeding occurs within 15 seconds of probing. Periodontitis was said to be present if PPD of 4 mm in at least one site out of the six sides per tooth measured from the free gingival margin to the bottom of the gingival sulcus/periodontal pocket according to the WHO definition of periodontitis.[9] Mild periodontitis was present when CAL loss of 3 mm occurred in at least three sites in different teeth but not three or more sites with CAL loss of 5 mm.[27] Moderate periodontitis was present when CAL loss of 5 mm occurred in at least three sites in different teeth but not three or more sites with CAL loss of 7 mm.[27] Severe periodontitis was present when CAL loss of 7 mm presenting in at least three sites, in different teeth.[27]

Statistical analysis was performed using SPSS Version 21. Frequencies and percentages were calculated. All the variables were stratified into groups to control confounding. Study had a power of 90%. Statistical significance was considered at a 5% level with a p-value of <0.05. Chi-square test had been applied on all the variables as all of them after stratification, had been converted into categorical variables. Educational level, socioeconomic status and maternal nutrition had been dichotomized so to allow calculation of Odd's Ratio with a 95% confidence interval. Multivariate logistic regression had then been applied to see the independent effect of the different variables put into the model.

RESULTS

Among cases, periodontitis was present in 49 (61.3%) mothers and absent in 31 (38.8%) of mothers. Among controls, periodontitis was present in 22 (27.5%) mothers and absent in 58 (72.5%) mothers (Figure-1). Among 49 cases with periodontitis, mild periodontitis was present in 30 (61.2%) mothers, moderate periodontitis in 11 (22.4%) mothers and severe periodontitis in 8 (16.3%) mothers. Among 22 controls with periodontitis, mild periodontitis was present in 16 (72.7%) mothers, moderate periodontitis in 4 (18.2%) mothers and severe periodontitis in 2 (9.1%) mothers (Figure 2). Odd's Ratio was calculated to be 4.167 (95% CI: 2.142-8.109, p=0.000) which was statistically significant. Educational level, socioeconomic status, maternal nutrition and moderate/severe anaemia were also statistically significant (p<0.05). Whereas tobacco use, heavy physical activity and number of antenatal visits were statistically insignificant (p>0.05) (Table-1).

On multivariate logistic regression, Adjusted Odd's Ratio of periodontitis was calculated to be 3.173 (95 % CI: 1.429-7.047, p=0.005) which remained statistically significant. Other significant variables put into the model namely educational level, socioeconomic status, maternal nutrition and anaemia also remained significant after regression analysis (Table-2).
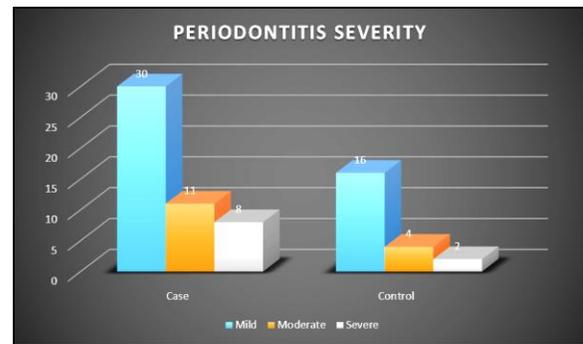

Figure-1: Periodontitis by severity

Table-1: Details of the study variables.

Variable	Groups	Cases	Controls	ODD's ratio	95% confidence interval	*p*-value
Periodontitis	Present	49	22	4.167	2.142–8.109	0.000
	Absent	31	58			
Educational Level	Below High School	60	20	6.600	3.302–13.192	0.000
	High School and Above	25	55			
Number of Antenatal Visits	≥4 Visits	53	52	1.057	0.550–2.030	0.868
	<4 Visits	27	28			
Socioeconomic Status	Upper Class	19	52	5.962	2.990–11.888	0.000
	Lower Class	61	28			
Heavy Physical Activity	Present	38	28	1.680	0.890–3.172	0.108
	Absent	42	52			
Maternal Nutrition	Under nutrition	46	23	3.353	1.739–6.464	0.000
	Good Nutrition	34	57			
Tobacco Use	Yes	4	5	0.789	0.204–3.054	0.732
	No	76	75			
Moderate and Severe Anaemia	Present	21	8	3.203	1.323–7.755	0.008
	Absent	59	72			

Table-2: Multivariate logistic regression analysis

Variable	Adjusted ODD's ratio	95% confidence interval	*p*-value
Periodontitis	3.173	1.429–7.047	0.005
Educational Level	3.408	1.452–7.996	0.005
Socioeconomic Status	3.173	1.366–7.368	0.007
Maternal Nutrition	3.071	1.392–6.778	0.005
Moderate and Severe Anaemia	3.035	1.052–8.756	0.040

DISCUSSION

In this study, it was determined whether mothers who suffered from periodontitis during pregnancy have a greater chance of delivering a low birth weight baby or not by assessing periodontitis as an independent risk factor for LBW by excluding other risk factors in preterm, term and post-term babies.

Maternal periodontitis was found to be more in cases (49) than in controls (22). Mothers with periodontitis had a 3.173 times greater chance of delivering a low birth weight baby than a normal birth weight baby (aOR: 3.173, 95 % CI: 1.429–7.047, *p*=0.005). The distribution of periodontitis severity was more in cases (30 mild, 11 moderate, 8 severe) than in controls (16 mild, 4 moderate, 2 severe). It was first pointed out in 1996[28] that maternal periodontal disease results in a seven times greater risk of a preterm low birth weight infant delivery. This was similar to some other studies which had a significant association between periodontitis and LBW[7,9,12,19,27–33] (*p*<0.05). But the results were in contrast with some of the other studies[14–18] which did not an association between the two (*p*>0.05). So there was a greater severity of periodontitis in mothers of LBW babies rather than the mothers of NBW babies.

In Pakistan, a study from Karachi[34] had demonstrated an association between periodontal disease and APOs but not LBW. Another study from Karachi[35] demonstrated an association between maternal periodontal disease and preterm birth.

The biological mechanism behind this relation involves bacterial infiltration of the periodontium. Bacterial toxins stimulate chronic inflammation, the periodontium breaks down and undergoes destruction, and pockets are created which become infected and ultimately the teeth become mobile. This triggers recurrent bacteraemia, which elicits in an indirect way the hepatic acute phase response. This process produces cytokines, prostaglandins like Prostaglandin E2 and interleukins especially IL-6 and IL-8, which have an effect on pregnancy.[36] Maternal periodontal infection also influences LBW delivery through direct attack of bacteria on the amnion which leads to preterm labour and premature rupture of membranes.[37] Gram negative bacterial infection releases lipopolysaccharide (LPS) which interacts with the host cells[27]. The immune system responds by raising the levels of inflammatory cytokines like PGE2, IL-1 and Tumour Necrosis Factor-α (TNF-α) by trophoblasts and chorioamnionic cells. This results in the rupture of membranes and growth retardation in pregnant women[27]. This is also reaffirmed by studies in animal models.[28]

The study population found in studies with insignificant results and/or with a comparatively lesser Odd's Ratio were often seen to be from the Americas or from Europe, in which periodontal disease and LBW both occurred less in the population. Whereas studies carried out in other continents and in an Asian country like Pakistan, there were different results as periodontitis and LBW is more common here. The different results can also be due to the difference between various definitions of periodontitis as the criteria for the diagnosis of periodontitis is often unclear[38] with the possibility of false positive diagnosis, along with use of different methodologies and study designs in different studies[39].

For periodontitis to be present in this study, the WHO criterion is used in which there is at least one site with PPD ≥4 mm and studies like those carried out by Jacob and Nath[9] used this criterion. It was practical to use a definition showing lesser destruction of periodontal tissues as the population of primi-parous mothers selected are younger. Similar to the above study mentioned, a full mouth periodontal examination with six sites per tooth is done in this study as it allows us to get a better picture of the prevalence of periodontal disease in the sample selected.[9]

Educational level (aOR: 3.408, 95% CI: 1.452–7.996, *p*=0.005), socioeconomic status (aOR: 3.173, 95% CI: 1.366–7.368, *p*=0.007), maternal nutrition (aOR: 3.071, 95% CI: 1.392–6.778, *p*=0.005) and moderate/severe anaemia (aOR: 3.035, 95% CI: 1.052–8.756, *p*=0.040) were found to have statistically significant association with LBW. Whereas, number of antenatal visits (OR: 1.057, 95% CI: 0.550–2.030, *p*=0.868), heavy physical activity (OR: 1.680, 95% CI: 0.890–3.172, *p*=0.108) and tobacco use (OR: 0.789, 95% CI: 0.204–3.054, *p*=0.732) were found to have a statistically insignificant association with LBW.

The strengths of this study are that it has an adequate sample size and power for the evaluation of the research question, other risk factors of LBW were

taken into account and the independent effect of periodontitis was seen, for measuring periodontitis both PPD and CAL were used and not only the presence but the severity of periodontitis was also ascertained. The limitations of the study are a possibility of recall bias as it is a case control study, non-institutional deliveries are not included and it was not possible to control all possible known and unknown risk factors of LBW.

CONCLUSIONS

It is expected that the results from this study will help along with other studies to fill the knowledge gaps in this research problem especially in Pakistan in general and Abbottabad in particular. In a nutshell, it is concluded that periodontitis seems to be a potential significant independent risk factor for LBW. Periodontitis is a modifiable risk factor so preventive measures in the form of health education, oral hygiene instructions regarding its prevention and use of scaling and root planning should be employed. This can be done if pregnant women are educated to take special care of their periodontal health with the help of antenatal dental check-ups from a dentist or periodontologist and they in turn can offer them periodontal treatment which can be safely, easily and successfully carried out. Furthermore, oral and periodontal health care programs can be set up for the benefit of the pregnant mothers. This will reduce the incidence of LBW to some extent. Health care professionals can cooperate with each other and form a multidisciplinary team for the better management of a pregnant patient. Such a study can also act as a bridge between medicine and dentistry and will help in developing better strategies for the oral and general health of the mother and child. To further explore this problem, population based studies should be carried out with better study designs.

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AUTHOR'S CONTRIBUTION

NSK: Study concept, design, literature search, data collection, analysis, interpretation and write up. RNA, MUR, ZR: Study concept, interpretation and proof-reading. SN: Study concept, data collection, and interpretation, proof-reading. SFM: Data analysis and interpretation. FS, AFN, HS, RSS: Study design and proof-reading.

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