Maternal Dental Health and Low Birth Weight Among Term Deliveries

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Abstracts: Background: Giving birth to infants of low birth weight (LBW) (less than 2,500 grams) is a major public health problem worldwide. In an attempt to identify modifiable risk factors for LBW in Saudi Arabia, the present research was undertaken to investigate a potential association between maternal dental health and dental care during pregnancy with LBW due to fetal growth retardation. **Material & Methods**: A case-control study was conducted on a group of post partum mothers, at two major hospitals, in Jeddah city. The case group (47 women) is defined as those mothers who delivered an infant weighing <2500g and born at term (i.e. ≥ 37 weeks of gestation), while the control group (58 mothers) were defined as women who delivered at term infants weighing ≥2500g. Data on previous and current known risk factors and dental care services were obtained from the patients' medical records and interviews. Maternal anthropometric data and DMFT scores were taken. **Results:** The selected case and control groups were relatively homogenous, based on their demographic, social and anthropometric data. However, there were significant differences between the groups in the distribution of some variables which could be associated with LBW in the study population. These include decrease in the gestational age; parity; previous delivery of LBW as well as maternal hypertension and anemia. Although the mothers in both groups had high unmet dental care needs, neither the DMFT scores nor the utilization of different dental treatments and radiographs were found to have a possible role in LBW; (*P*-value >0.05). **Conclusion:** The data of the present study showed no association between maternal dental health or dental care with LBW due to intrauterine growth retardation.

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Introduction

Giving birth to infants of low birth weight (<2,500 grams) is a major public health problem worldwide. Fifteen per cent of the global births have low birth weight, 96.5% of whom are in developing countries. Its significance being due to its association with immediate as well as late complications **(Blanc and Wardlaw, 2005; United Nations Children's Fund and World Health Organization, 2004**). Low birth weight (LBW) occurs when a baby is born at < 37 weeks (known as preterm birth) and/or being born too small for gestational age due to intrauterine growth retardation (IUGR) **(United Nations Children's Fund and World Health Organization, 2004**). Three maternal factors were associated mostly with the preterm or LBW deliveries: poor maternal nutritional status before pregnancy, short stature and poor nutrition during pregnancy (**Han, *et al*., 2012; Liu, *et al*., 2012**). Other factors include: parity, birth interval, previous complications, antenatal care, hypertension, infections, cervical incompetence, smoking, alcohol intake and stress (**Erickson and Arbour, 2012, Kramer, 2013, Valero De Bernabe, *et al*., 2004**). However, some LBW cases are of unknown etiology (**Kramer, 2013**).

The association between the oral health status and a variety of systemic conditions has received worldwide attention (**Manjunath, *et al*., 2011**). Since long time many investigators have looked into the association between the oral health status of pregnant women and pregnancy outcomes from different perspectives. For instance, several studies *(***Dasanayake, *et al*., 2001; Kothiwale, *et al*., 2014; Lopez, *et al*., 2002; Offenbacher, *et al*., 1996**) and systematic reviews found a consistent association between periodontitis and premature birth and/or LBW (**Baskaradoss, *et al*., 2012; Chambrone, *et al*., 2011**). Although some researchers found that early treatment of periodontal disease during pregnancy reduced rates of preterm and LBW babies (**Lopez, *et al*., 2002; Offenbacher, *et al*., 2006**), others failed to report such an effect with nonsurgical periodontal treatment (**Michalowicz, *et al*., 2006**). From another aspect, a case control study related the low birth weight to dental radiography and they reported a strong association for low birth weight with exposures higher than 0.4 mGy, accusing the thyroid exposure of the mother as being the potential etiology for low birth weight (**Hujoel, et al., 2004**). Because of the mercury in the dental amalgam, which in an animal study was associated with fetal growth retardation (**Gale and

Ferm, 1971), dentists were advised in many European countries not to use amalgam fillings during pregnancy (**Anderson, *et al*., 1998**). However, Hujoel et al from a retrospective data couldn't find an increased risk for LBW in women who received amalgam fillings during pregnancy (**Hujoel, *et al*., 2005**). Up to our knowledge, no published report has yet investigated the relationship of maternal dental health or dental caries and preterm / low birth weight rates. If it is proved to be true, a new intervention strategy to reduce the incidence of LBW will be found, as long as the dental diseases are preventable and readily managed.

In Saudi Arabia, several studies have investigated the LBW predictors (**Abdelmoneim, 2004; El-Gilany and Hammad, 2010; Hisham and Moawed, 2000**), however, the studies that explored the role of oral health in the pregnancy outcome were scanty and all focused on periodontal disease (**Al-Attas, 2004; Mokeem, *et al*., 2004**). Because women's child bearing behavior is culturally-bound, regional rather than universal data should be available to explain such health issue in our country. Thus data is indeed essential in the design of interventions and evaluation of programs targeted to reduction of the incidence of LBW regionally or locally. The aim of the present study was to assess the relationship between maternal dental health and dental care during pregnancy with LBW in term deliveries in Jeddah city, Saudi Arabia.

Materials and Methods

A case-control cross sectional study was conducted on a group of post partum mothers. The study population included a multi-ethnic group of women, who gave single live birth at two major hospitals: Maternity and Children and King Abdulaziz University Hospitals in Jeddah city. All mothers were selected and enrolled into the case or control groups within three days of delivery. The case or patients group is defined as those mothers who delivered an infant weighing less than 2500g and born at term (i.e. > 37 weeks of gestation), while the control group mothers were defined as women who delivered at term infants weighing 2500g or more. All mothers in the patients' and control groups were in good physical and psychological health and matched within the groups by race and age. All subjects in both groups gave informed signed consent prior to participation in the study. Demographic data of the participants as well as the detailed information about previous and current pregnancies and known risk factors for LBW were collected from the medical files whenever available and from interviewing questionnaire. The latter included also information regarding the use of vitamins, iron supplements, medical and dental care services during the current pregnancy. All mothers voluntarily underwent conventional oral examination and anthropometric data measuring by a single calibrated examiner (the author). The anthropometric data included mother's height, weight and body mass index (BMI). The maternal weight and height were recorded in kilograms and centimeters respectively according to the standard methods, when the mothers were wearing light clothes and barefooted. The BMI was calculated as maternal weight in kilograms divided by maternal height in square meters. Dental examination was performed in the maternity ward with mothers lying flat, under the daylight and illumination of torch light source using dental probe and mouth mirror. The dental examination were done according to the criteria and recommendations of the World Health Organization in 1997, using the decayed missing filled teeth (DMFT) index (**World Health Organization, 1997**). The ethics committee of the KAU, Faculty of Dentistry approved the study protocol.

Statistical analysis:

Descriptive statistics such as frequency and percentages were used using SPSS, version 16.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were compared by the independent t-test while the categorical variables were compared by the chi-square, Fisher's exact or Monte Carlo exact tests when applicable. To control possible confounding effects, multiple logistic regression analysis and odd ratios with 95% confidence intervals were calculated. Statistical significance was defined as $p<0.05$.

Results

The study population comprised 47 cases and 58 controls. The population in this study was relatively homogenous, based on their demographic and socio-economic status; table (1). The mothers were married and originated from five different countries but Saudi origin was the dominating (52.3%). The mean ages of the mothers in the case and control groups were 26.74±6.250 and 27.36±6.365 years respectively. The majority of the mothers were housewives (91.2%) and 41% had a high school education level or beyond and 42.9% were with 3000-6000 Saudi Riyals monthly income. All mothers in both groups had an average of 3 kids (parity) and 3 previous pregnancies (gravidity); table (2). Four (3.8%) mothers in the study group were tobacco users; one of them was a regular cigarette smoker, while the rest were muasel "hubble-bubble" users. Interestingly, mothers in the groups not only shared the same demographic characteristics, but also the anthropometric data (maternal weight, height and BMI); where the difference was statistically insignificant ($P> 0.05$). Tables (2 and 3) summarize some known LBW maternal risk factors among the case and the control groups. As it has been shown in table (2), mothers' age, parity, gravidity as well as anthropometric data were not associated with LBW; P>0.05. However, the mean of gestational age was statistically significantly lower in the LBW groups compared to the controls; 38.87 versus 39.50 weeks. In addition, the results revealed that, the mothers' hemoglobin level during delivery, history of genitourinary tract infections and utilization of medical antenatal care as well as the use of vitamins and iron supplements were all not associated with LBW; P-value > 0.05. However, the positive history of previous delivery of LBW babies and hypertension were strongly associated with LBW among the studied sample, the odds ratios were 8.31 and 9.98 respectively. The status of dental health as well as the dental care during the pregnancy were evaluated among the groups and assessed in relation to the LBW. The former was evaluated based on the DMFT index and the latter were inquired in a structured questionnaire. Almost similar prevalence rates of caries were found among the case and control groups (78.7% and 79.3% respectively). The mean DMFT scores in the case and control groups were not statistically different (6.26±4.739 and 6.71±5.442 teeth respectively). Also was the prevalence of the missing and filled teeth among the LBW and the control groups, P-value > 0.05; table (4). The results of the oral care questionnaire are illustrated in table (5). Worth notice was that, although the mothers in both groups had high levels of dental disease and treatment needs based on DMFT index, the results showed low utilization of the dental services among the groups. Only 9 (19.1%) women in the patients' group in contrast to 7(12.1%) in the control visited the dentist during current pregnancy. Restorative and endodontic treatments were the main cause of the dental visit among the case group, similarly were the reasons in the control group beside the periodontal treatment. Overall, neither the DMFT scores nor the utilization of the different dental treatments and radiographs seemed to have a possible role in LBW; P-value > 0.05. To find the adjusted odds ratio as well as to control cofounders; a multiple stepwise logistic regression model was performed. Again, the results confirmed that those which had association with LBW in univariate analysis, were also found to have a P value < 0.05 in the model plus the parity and presence of anemia (hemoglobin level <9 grams per deciliter); table (6).

Discussion

In developed countries half of the LBW births are preterm (<37 wk gestation), while most LBW babies in developing countries are born at term and are affected by intrauterine growth restriction (**Blanc and Wardlaw, 2005; United Nations Children's Fund and World Health Organization, 2004**). In an attempt to identify modifiable risk factor for LBW, the present research was undertaken to investigate a potential association between maternal dental health and dental care during pregnancy with LBW due to fetal growth retardation in Jeddah population, the second city of Saudi Arabia. Different incidence rates of LBW have been reported in Saudi Arabia with the highest rate of 13.6% and 18.8% in El-Taif (**Madani and Nasrat, 1995**) and Abha (**Ismaeil, *et al*., 2012**) cities respectively, which may be attributed to hypoxia of high altitude. Since long time, it was suggested that oral infections negatively affect the general health (**Offenbacher *et al*., 1996**). Though the systemic effects of periodontal diseases have been extensively studied (**Baskaradoss *et al*., 2012; Chambrone, *et al*., 2011**), little has been mentioned about the systemic effects of dental caries. Actually, similar results could be expected as both are chronic infectious diseases. The systemic inflammatory responses to dental caries have been described by De Soet et al (**2003**). Moreover, some authors found that kids with early childhood caries exhibited growth retardation compared to the controls, and they had a "catch-up growth" with dental rehabilitation (**Acs G, *et al*., 1992**). So it can be hypothesized that maternal tooth decay could affect the offspring growth directly; through the inflammatory response, or indirectly; through the toothache. The latter could alter the eating and sleeping patterns as well as dietary intake of the pregnant mothers leading to fetal malnutrition and growth retardation.

The current study was conducted among mothers randomly selected from the same wards at the same time. The groups selected were almost homogenous, based on their demographic, social and anthropometric data. However, there were significant differences between the groups in the distribution of some variables which may be associated with LBW in the study population. These include decrease in the gestational age; parity; previous delivery of LBW as well as maternal morbidity during pregnancy including hypertension and anemia. These risk factors are in accordance with those reported in several other national (**Ismaeil, *et al*., 2012; Rasheed and Rahman, 1995**) and international (**Kramer, 2013, Valero De Bernabe, *et al*., 2004**) studies. However, the present work failed to find any association between LBW and dental health or dental care visits. Approximately 80% of the mothers among the LBW and control groups have dental caries, with mean DMFT scores of 6.26 and 6.71 respectively. There is a lack of consistent data on the caries prevalence among Saudi population, but according to the recent systematic review (**Al Agili, 2013**) and a meta analysis study (**Khan, *et al.*, 2013**); the prevalence of dental caries is high across Saudi Arabia and varies by geographic location. Our data is comparable to Farsi results, who reported mean DMFT of 7.59 among Jeddah population (**Farsi, 2008**). It might be due to the high caries prevalence rates recorded in both patients' and control groups as well as the small sample size; we failed to find an association between caries and the IUGR in the current research. Additionally, we could not find any published report of such sort of study for comparison. Although some researchers reported a relationship between the growth retardation and dental caries among children (**Acs, *et al.*,1992**), a randomized controlled trial showed no significant improvement in children growth over 3 years with dental intervening treatment (**van Gemert-Schriks, *et al.*, 2011**). Also, a local report indicated that the permanent teeth of the children with stunted growth had low caries prevalence (**Abolfotouh, *et al.*, 2000)**. Unfortunately such data is further confusing and thus further multicentre research with large sample is needed to pros or cons such a relation between the IUGR and dental caries. The current results indicated that the average tooth loss among the case and control groups were 1.13 and 1.09 respectively and it increased with higher age groups. This result is in agreement with a local report, which covered ten regions in Kingdom of Saudi Arabia, and indicated that the average tooth loss was 1.24 at 20 to 29 years age group and it increases with age (**al Shammery, *et al.*, 1998**). The D and M components are the major indicators of unmet dental treatment needs. Unfortunately, the results showed that, a majority of the mothers had more decayed than treated teeth, reflecting a low restorative care level. Surprisingly, even with the mothers' high dental treatment needs, more than 80% of the studied mothers did not visit dentist during current pregnancy. It is noteworthy that, dental care in pregnancy is often overlooked and underestimated by pregnant women locally (**Al-Attas, 2007; Assery and Al-Saif, 1993**) and globally **(Keirse and Plutzer, 2010 ; Lydon-Rochelle, *et al.*, 2004**). Again, we could not find any relationship between the IUGR and the dental visits, types of dental treatment or utilization of dental radiography in any trimester of the current pregnancy. The possible explanation is attributed to the small sample size and small number of the mothers that visited the dentist during pregnancy. Thus, we cannot rely on the current results and further research in this area is justified, particularly with respect to the effect of different types of dental treatment and dental radiography. Knowing the type of dental care is important, because we knew that preventive care to women makes them less likely to develop periodontal disease, and protects them against adverse birth outcomes **(Lopez *et al.*, 2002; Offenbacher, *et al.*, 2006**), but what about other treatment modalities?. The need for epidemiological studies to establish evidence-based guides on the use of dental materials during pregnancy is frequently expressed in different countries **(Hujoel, *et al.*, 2005**). Both mercury (**Gale and Ferm, 1971**) and Resin-based (**Rubin, *et al.*, 2001**) dental filling materials in animal models have been associated with adverse pregnancy outcomes. Nevertheless, Hujoel et al investigated the mercury and resin dental fillings and other eight different non restorative types of dental care performed during pregnancy for possible increase in the LBW risk. In accordance with our work, their results showed that none of the investigated variables increased the LBW risk, and they also recommended further studies to establish evidence based guidelines for the dental materials use during pregnancy **(Hujoel, *et al.*, 2005**). However, the same authors reported a strong dose dependant correlation between dental radiography and term LBW, mostly during the first trimester (**Hujoel, *et al.*, 2004**). Unfortunately, we could not investigate such a relation as none of the mothers in our sample had dental radiography except one in the control group, so we can speculate that; the best strategy would be to have dental radiographs when it is necessary during pregnancy with proper shielding, until further multicentre longitudinal studies prove otherwise.

Overall, pregnant women usually demonstrate an increased need for orall health care during pregnancy due to different hormonal and physiological processes (**Barak, *et al.*, 2003**). A small sample size and the use of self-reported data on some of the variables are among the limitations of this study. Despite these limitations, our results illustrate to health care providers and policy makers that Jeddah pregnant women have high unmet dental care needs. These data which are preliminary at the best and need cautious interpretation lend further studies to assess the association between dental health status as well as dental care and IUGR (LBW).

Conclusion

Until evidence is found to the contrary, data of the present study showed no association between maternal dental health and dental care during pregnancy and LBW due to intrauterine growth retardation.

Table 1: Demographic data of the study population

Participants characteristics						Chi-square	P-value
		Patients(47)		Controls(58)			
Nationality	**Saudi**	24	51.1%	31	53.4%	**0.38**	**0.984**
	Yemeni	13	27.7%	14	24.1%		
	Indian	6	12.8%	9	15.5%		
	African	3	6.4%	3	5.2%		
	Palestinian	1	2.1%	1	1.7%		
Age(years)	**<20**	7	14.9%	9	15.5%	**0.61**	**0.895**
	21-25	17	36.2%	17	29.3%		
	26-35	19	40.4%	27	46.6%		
	>36	4	8.5%	5	8.6%		
Occupation	**Yes**	5	10.6%	4	6.9%	**0.46**	**0.496**
	No	42	89.4%	54	93.1%		
Education Level	**Uneducated**	8	17.0%	13	22.4%	**7.5**	**0.186**
	Primary	11	23.4%	10	17.2%		
	Middle	9	19.1%	11	19.0%		
	High school	8	17.0%	18	31.0%		
	Diploma	3	6.4%	0	0.0%		
	University	8	17.0%	6	10.3%		
Income (Saudi Riyals per month)	**Less 1500**	9	19.1%	6	10.3%	**5.05**	**0.283**
	1500-3000	14	29.8%	14	24.1%		
	3000-6000	18	38.3%	27	46.6%		
	6000-1000	2	4.3%	8	13.8%		
	>10000	4	8.5%	3	5.2%		

Table 2: **Assessment of LBW maternal risk factors (continuous variables)**

variables	group	N	Mean	Std. Deviation	t	P-value
Age	**patient**	47	26.74	6.250	-.498	**.619**
	control	58	27.36	6.365		
Children numbers	**patient**	47	2.74	1.775	-1.463	**.147**
	control	58	3.36	2.411		
Previous pregnancy numbers	**patient**	47	3.51	2.439	-.188	**.851**
	control	58	3.60	2.582		
Gestational age	**patient**	47	38.87	1.227	-2.850	**0.005 ****
	control	58	39.50	1.030		
Mother weight	**patient**	47	61.88	13.529	-.396	**.693**
	control	58	62.90	12.700		
Mother height	**patient**	47	154.62	5.951	-1.020	**.310**
	control	58	155.76	5.497		
Body mass index	**patient**	47	25.80	4.982	-.018	**.986**
	control	58	25.82	4.611		
Hemoglobin level	**patient**	47	10.8596	2.11919	-.401	**.690**
	control	58	10.9998	1.45766		

**Statistically highly significant*

Table 3: Assessment of LBW maternal risk factors (categorical variables)

		Group				Odds Ratio	95% Confidence Limits	
		Patient (47)		Control (58)		OR	LL	UL
		No.	%	No.	%			
Smoking habit	**No**	43	91.5	58	100.0			
	Yes	4	8.5	0	0.0	**12.10**	0.63	230.79
Utilization of Antenatal visits	**Yes**	33	70.2	41	70.7			
	No	14	29.8	17	29.3	**1.02**	0.44	2.38
Iron supplements	**Yes**	8	17.0	9	15.5			
	No	39	83.0	49	84.5	**0.90**	0.32	2.54
Vitamins supplements	**Yes**	16	34.0	19	32.8	**0.94**	0.42	2.13
	No	31	66.0	39	67.2			
Hypertension	**Yes**	7	14.9	1	1.7	**9.98***	1.18	84.27
	No	40	85.1	57	98.3			
Infections	**Yes**	3	6.4	0	0.0	**9.20**	0.46	182.77
	No	44	93.6	58	100.0			
Previous LBW	**Yes**	23	48.9	6	10.3	**8.31***	2.99	23.04
	No	24	51.1	52	89.7			

**Statistically significant*

Table 4: Comparison of D, M, F and DMFT index in patients and control groups

	Group	N	Mean	Std. Deviation	t	P-value
Decayed teeth	**Patient**	47	3.89	3.552	-.275	**.784**
	Control	58	4.10	4.132		
Missing teeth	**Patient**	47	1.13	1.715	.132	**.895**
	Control	58	1.09	1.490		
Filled teeth	**Patient**	47	1.23	2.139	-.638	**.525**
	Control	58	1.52	2.356		
DMFT index	**Patient**	47	6.26	4.739	-.448	**.655**
	Control	58	6.71	5.442		

Table 5: Dental care and treatment during current pregnancy

	Patients (47)		Control (58)		P-value
Visiting Dentist	**No.**	**%**	**No.**	**%**	
Once	6	12.8	3	5.2	**0.615**
Twice	2	4.3	2	3.4	
Three times	1	2.1	2	3.4	
No dental visit	38	80.9	51	87.9	
Visiting Reason					
Restorative treatment	4	8.5	2	3.4	**0.369**
Periodontal treatment	0	0.0	2	3.4	
endodontic treatment	2	4.3	2	3.4	
Examination	0	0.0	1	1.7	
Extraction	1	2.1	0	0.0	
TMJ treatment	1	2.1	0	0.0	
More than one answers	1	2.1	0	0.0	
No dental visit	38	80.9	51	87.9	
Radiography					
Yes	0	0.0%	1	1.7	**1.000**
No	47	100.0%	57	98.3	
Visiting time					
1st trim	4	8.5	3	5.2	**0.735**
2ed trim	1	2.1	2	3.4	
3ed trim	3	6.4	2	3.4	
1st & 2ed trim	1	2.1	0	0.0	
No dental visit	38	80.9	51	87.9	

P = Fisher's exact P (2 categories) or Monte Carlo exact P (more than 2 categories)

Table 6: Logistic Regression Model taking all factors

	P-value	Odds Ratio	95% Confidence Limits	
			Lower	Upper
Previous LBW	.000	**12.41**	3.49	44.05
Anemia	.027	**8.46**	1.28	56.10
Hypertension	.043	**18.02**	1.09	297.29
Gestational age	.024	**1.68**	1.07	2.63
Parity	.011	**1.46**	1.09	1.94
Constant	.001	**.00**		

Anemia = Hb< 9

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References

1. Abdelmoneim I. A study of determinants of low birth weight in Abha, Saudi Arabia. Afr J Med Med Sci (2004) 33 (2):145-8
2. Abolfotouh MA, Hassan KH, Khattab MS, Youssef RM, Sadek A and El-Sebaiei M. Dental caries: experience in relation to wasting and stunted growth among schoolboys in Abha, Saudi Arabia. Ann Saudi Med (2000) 20 (5-6):360-3
3. Acs G, Lodolini G, Kaminsky S and Cisneros GJ. Effect of nursing caries on body weight in a pediatric population. Pediatr Dent (1992) 14 (5):302-5
4. Al-Attas SA. The effect of socio-demographic factors on the oral health knowledge, attitude and behavior in a female population. Saudi Med J (2007) 19 (1):27-36
5. Al-Attas SA. Maternal periodontal health and intrauterine growth retardation in Jeddah City, Saudi Arabia. Ainshams Dental J (2004) 7 (1):49-58
6. Al Agili DE. A systematic review of population-based dental caries studies among children in Saudi Arabia. Saudi Dent J (2013) 25 (1):3-11
7. al Shammery A, el Backly M and Guile EE. Permanent tooth loss among adults and children in Saudi Arabia. Community Dent Health (1998) 15 (4):277-80
8. Anderson BA, Arenholt-Bindslev D, Cooper IR, David P and Ecker P. Dental Amalgam: A report with reference to the Medical Devices Directive 93/42/EEC from an Ad Hoc Working group mandated by DGIII of the European Commission. (1998) (Angelholm, Sweden, Nordiska Dental AB): (http://www.nordiskadental.se/EUamalgam/eumain.htm).
9. Assery MK and Al-Saif KM. A survey of dental knowledge in Al-Jubail antenatal clinic population. Saudi Dent J (1993) 5 (1):13-16
10. Barak S, Oettinger-Barak O, Oettinger M, Machtei EE, Peled M and Ohel G. Common oral manifestations during pregnancy: a review. Obstet Gynecol Surv (2003) 58 (9):624-8
11. Baskaradoss JK, Geevarghese A and Al Dosari AA. Causes of adverse pregnancy outcomes and the role of maternal periodontal status - a review of the literature. Open Dent J (2012) 6:79-84
12. Blanc AK and Wardlaw T. Monitoring low birth weight: an evaluation of international estimates and an updated estimation procedure. Bull World Health Organ (2005) 83 (3):178-85.
13. Chambrone L, Guglielmetti MR, Pannuti CM and Chambrone LA. Evidence grade associating periodontitis to preterm birth and/or low birth weight: I. A systematic review of prospective cohort studies. J Clin Periodontol (2011) 38 (9):795-808
14. Dasanayake AP, Boyd D, Madianos PN, Offenbacher S and Hills E. The association between Porphyromonas gingivalis-specific maternal serum IgG and low birth weight. J Periodontol (2001) 72 (11):1491-7
15. de Soet JJ, Schriks MC, Kratz E, Poland DC, van Dijk W and van Amerongen WE. Dental caries related to plasma IgG and alpha1-acid glycoprotein. Caries Res (2003) 37 (2):79-84
16. El-Gilany AH and Hammad S. Body mass index and obstetric outcomes in pregnant in Saudi Arabia: a prospective cohort study. Ann Saudi Med (2010) 30 (5):376-80
17. Erickson AC and Arbour LT. Heavy smoking during pregnancy as a marker for other risk factors of adverse birth outcomes: a population-based study in British Columbia, Canada. BMC Public Health (2012) 12 :102
18. Farsi N. Dental caries in relation to salivary factors in Saudi population groups. J Contemp Dent Pract (2008) 9 (3):16-23
19. Gale TF and Ferm VH. Embryopathic effects of mercuric salts. Life Sci II (1971) 10 (23):1341-7
20. Han Z, Mulla S, Beyene J, Liao G and McDonald SD. Maternal underweight and the risk of preterm birth and low birth weight: a systematic review and meta-analyses. Int J Epidemiol (2012) 40 (1):65-101
21. Hisham TJ and Moawed SA. The relation of low birth weight to psychosocial stress and maternal anthropometric measurements. Saudi Med J (2000) 21 (7):649-54
22. Hujoel PP, Bollen AM, Noonan CJ and del Aguila MA. Antepartum dental radiography and infant low birth weight. JAMA (2004) 291 (16):1987-93
23. Hujoel PP, Lydon-Rochelle M, Bollen AM, Woods JS, Geurtsen W and del Aguila MA. Mercury exposure from dental filling placement during pregnancy and low birth weight risk. Am J Epidemiol (2005) 161 (8):734-40
24. Ismaeil FMR and Al Musa HM. Prevalence and determinants of low birth weighst in Abha City, KSA. Life Science Journal (2012) 9 (4):2490-2495

25. Keirse MJ and Plutzer K. Women's attitudes to and perceptions of oral health and dental care during pregnancy. J Perinat Med (2010) 38 (1):3-8
26. Khan SQ, Khan NB and Arrejaie AS. Dental caries. A meta analysis on a Saudi population. Saudi Med J (2013) 34 (7):744-9
27. Kothiwale SV, Desai BR, Kothiwale VA, Gandhid M and Konin S. Periodontal disease as a potential risk factor for low birth weight and reduced maternal haemomglobin levels. Oral Health Prev Dent (2014) 12 (1):83-90
28. Kramer MS. The epidemiology of low birthweight. Nestle Nutr Inst Workshop Ser (2013) 74: 1-10
29. Liu Y, Dai W, Dai X and Li Z. Prepregnancy body mass index and gestational weight gain with the outcome of pregnancy: a 13-year study of 292,568 cases in China. Arch Gynecol Obstet (2012) 286 (4):905-11
30. Lopez NJ, Smith PC and Gutierrez J. Higher risk of preterm birth and low birth weight in women with periodontal disease. J Dent Res (2002) 81 (1):58-63
31. Lopez NJ, Smith PC and Gutierrez J. Periodontal therapy may reduce the risk of preterm low birth weight in women with periodontal disease: a randomized controlled trial. J Periodontol (2002) 73 (8):911-24
32. Lydon-Rochelle MT, Krakowiak P, Hujoel PP and Peters RM. Dental care use and self-reported dental problems in relation to pregnancy. Am J Public Health (2004) 94 (5):765-71
33. Madani KA and Nasrat HA. Low birth weight in Taif Region, Saudi Arabia. Eastern Mediterranean Health Journal (1995) 1(1): 47-54
34. Manjunath BC, Praveen K, Chandrashekar BR, Rani RM and Bhalla A. Periodontal infections: a risk factor for various systemic diseases. Natl Med J India (2011) 24 (4):214-9
35. Michalowicz BS, Hodges JS, DiAngelis AJ, Lupo VR, Novak MJ, Ferguson JE, Buchanan W, Bofill J, Papapanou PN, Mitchell DA, Matseoane S and Tschida PA. Treatment of periodontal disease and the risk of preterm birth. N Engl J Med (2006) 355 (18):1885-94
36. Mokeem SA, Molla GN and Al-Jewair TS. The prevalence and relationship between periodontal disease and pre-term low birth weight infants at King Khalid University Hospital in Riyadh, Saudi Arabia. J Contemp Dent Pract (2004) 5 (2):40-56
37. Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maynor G, McKaig R and Beck J. Periodontal infection as a possible risk factor for preterm low birth weight. J Periodontol (1996) 67 (10 Suppl):1103-13
38. Offenbacher S, Lin D, Strauss R, McKaig R, Irving J, Barros SP, Moss K, Barrow DA, Hefti A and Beck JD. Effects of periodontal therapy during pregnancy on periodontal status, biologic parameters, and pregnancy outcomes: a pilot study. J Periodontol (2006) 77 (12):2011-24
39. Rasheed P and Rahman J. Predictors of Saudi birth weights: A multiple regression analysis. Saudi Med J (1995) 16 (1):23-29
40. Rubin BS, Murray MK, Damassa DA, King JC and Soto AM. Perinatal exposure to low doses of bisphenol A affects body weight, patterns of estrous cyclicity, and plasma LH levels. Environ Health Perspect (2001) 109 (7):675-80
41. United Nations Children's Fund and World Health Organization. Low Birthweight: Country, regional and global estimates. UNICEF, New York (2004)
42. Valero De Bernabe J, Soriano T, Albaladejo R, Juarranz M, Calle ME, Martinez D and Dominguez-Rojas V. Risk factors for low birth weight: a review. Eur J Obstet Gynecol Reprod Biol (2004) 116 (1):3-15
43. van Gemert-Schriks MC, van Amerongen EW, Aartman IH, Wennink JM, Ten Cate JM and de Soet JJ. The influence of dental caries on body growth in prepubertal children. Clin Oral Investig (2011) 15 (2):141-9
44. World Health Organization. Oral health services methods, 4th ed. WHO Geneva (1997)

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