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치의과학석사 학위논문

**Association between obesity and  
periodontitis in pregnant women**

임신 중기 임부의  
비만과 치주염 간 연관성

2014년 8월

서울대학교 대학원  
치의과학과 예방치학전공

이 효 진

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지도교수 배 광 학

이 논문을 치의과학석사 학위논문으로 제출함

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# Association between obesity and periodontitis in pregnant women

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## 1. Objective

The purpose of this study was to investigate whether overweight and obesity prior to pregnancy is associated with periodontitis during pregnancy.

## 2. Methods

The study examined a total of 315 pregnant women at 21 to 24 weeks of gestation. Overweight and obesity was defined based on criteria proposed by the World Health Organization Expert Consultation and Korean Society for the Study of Obesity. Periodontal conditions were assessed by measuring periodontal clinical attachment loss (CA loss). To investigate that obese pregnant women have increased the risk according to the extent of periodontitis, the data was divided into two groups: generalized periodontitis and localized periodontitis. A comparison between underweight, normal weight, and overweight / obese groups for explanatory variables was analyzed using the chi-square test for

categorical variables and an analysis of variance for continuous variables. Multivariate logistic regression analysis was carried out with adjustments for age, health and oral health behaviors, and obstetric information.

### **3. Results**

Age, age at first delivery, periodontitis (two or more interproximal sites with CA loss  $\geq$  4mm not on the same tooth), and periodontal conditions were significantly associated with body mass index (BMI) ( $P < 0.05$ ). The adjusted odds ratio of periodontitis was 4.57 (95% confidence interval: 2.30 to 9.07) for overweight and obese women (BMI  $\geq$  23 kg/m<sup>2</sup>), after adjusting for all of the covariates. A dose-effect relationship was observed for this association when extent of the disease was taken into consideration.

### **4. Conclusions**

There is a strong association between overweight / obesity prior to pregnancy and periodontitis in pregnant women.

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**Keywords** : Overweight, obesity, body mass index, periodontitis, pregnant women, pregnancy

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# 1. Introduction

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health and are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases, other life-threatening diseases.<sup>1,2)</sup> In addition, obesity is a rapidly growing health-related problem in the world.<sup>3)</sup> Flegal et al.<sup>4)</sup> reported that the prevalence of obesity (defined as body mass index [BMI]  $\geq 30$  kg/m<sup>2</sup>) was 31.9% among women aged 20–39 years in 2009 to 2010 in the United States, based on data from the National Health and Nutrition Examination Survey (NHANES). In Korea, the prevalence of obesity (defined as BMI  $\geq 25$  kg/m<sup>2</sup>) for Korean women aged 20–39 years was 19.7% in 2011 according to the Korea National Health and Nutrition Examination Survey.<sup>5)</sup>

Periodontitis is a chronic inflammatory disease caused by bacterial infection of the supporting tissues around the teeth and can result in the formation of soft tissue pockets, loss of connective tissue and bone support, loosening of teeth, pain, and impaired mastication.<sup>6,7)</sup> Periodontal disease is one of the most common chronic diseases in the world, and it is also one of the main causes necessitating extraction of permanent teeth.<sup>8,9)</sup> A study based on data from NHANES 2009–2010 reported that the

prevalence of periodontitis in adults aged 30 years and older was 47.2% in the United States (U.S.).<sup>10</sup> In Korea, the prevalence of periodontitis (defined as a community periodontal index<sup>11</sup> greater than or equal to code 3) is 28.9% among adults  $\geq$  30 years of age in 2010.<sup>12)</sup>

Recent epidemiologic studies have indicated that there is an association between obesity and periodontitis.<sup>13-18)</sup> Because obesity can impact metabolic and immune parameters, it may increase the host's susceptibility to periodontal disease.<sup>14,19)</sup> In addition, recent studies have indicated that several bioactive substances known as adipocytokines, which are secreted from adipose tissue, may directly injure periodontal tissue.<sup>20,21)</sup> Thus, obesity could be a potential risk factor for periodontal disease.<sup>15)</sup> Because adipokines play an important role in metabolic regulation, obesity is related to the development of type 2 diabetes mellitus which is primarily considered as a risk factor for periodontitis.<sup>22,23)</sup>

The association between obesity and periodontitis could be stronger in females than males. Dalla Vecchia et al.<sup>13)</sup> found that obese females were significantly more likely to have periodontitis than normal weight females (Odds Ratio [OR] = 2.1) using multivariate analyses, while there was no significant association between periodontitis and obesity in males. Some previous studies also reported that a significant association between obesity and periodontitis was stronger in females than in males.<sup>24,25)</sup>

This stronger association in females could be found more clearly in pregnant women as pregnancy may increase the host's susceptibility to a systemic inflammation by pregnancy-related hormonal influences on the immune system.<sup>26,27)</sup>

However, there were few studies that investigated the association between obesity and periodontitis in pregnant women.<sup>28-30)</sup> Vogt et al.<sup>28)</sup> reported that the prevalence of periodontal disease in low-risk pregnant women was associated with gingival bleeding on probing, more advanced gestational age, and obesity which was only considered as one of variables related to periodontal disease. The other studies were only focused on diabetic pregnant women, but not pregnant women.

Therefore, the purpose of this study was to investigate if overweight and obesity before pregnancy is associated with periodontitis during pregnancy.

## 2. Materials and Methods

### 2.1 Study design and subject selection

This study was conducted in compliance with the principles of the Helsinki Declaration. Ethical clearance of the study was approved by the Institutional Review Board (IRB) of Seoul National University Hospital, Seoul, Korea (H-0808-003-252).

This study was designed as a hospital-based study and the study sample included 315 patients in the Department of Obstetrics and Gynecology, Seoul National University Hospital from March 2009 to December 2012. Eligible healthy women with a singleton pregnancy were examined at 21 to 24 weeks of gestation. Women were excluded from the study if they were < 20 years of age, had < 20 teeth, a multifetal gestation, alcohol or drug abuse, systemic conditions such as diabetes or chronic hypertension, or any infectious disease requiring antibiotic treatment. The history of diabetes or hypertension was obtained from the medical records including systemic diseases. All patients provided written informed consent before participating in the study.

## 2.2 Demographic and health information

All patients responded to a demographic questionnaire including pre-pregnant weight and height which were self-reported for BMI; health behaviors including smoking, drinking, and weekly exercise before pregnancy; oral health behaviors & dental care utilization including the regular use of floss or interdental brush and scaling within one year prior to pregnancy; obstetric information including parity and age at first delivery, all of which were conducted in a face-to-face interview. Smoking was defined as the experience of smoking before pregnancy (no / yes). Drinking was defined as frequency of drinking alcohol per week before pregnancy (no / < once per week /  $\geq$  once per week). Exercise was defined as frequency of regular exercise before pregnancy (no / 1 to 2 times per week /  $\geq$  3 times per week).

## 2.3 Overweight and obesity based on BMI

In this study, BMI was used to define overweight and obese participants. The BMI was calculated by dividing weight in kilograms by the square of height in meters. The study followed

the guidelines based on the World Health Organization (WHO) and Korean Society for the Study of Obesity (KSSO)'s criteria for Asian populations to categorize the subjects into three groups which included: underweight (BMI < 18.5 kg/m<sup>2</sup>), normal weight (BMI of 18.5 to 22.9 kg/m<sup>2</sup>), and overweight and obese (BMI ≥ 23 kg/m<sup>2</sup>).<sup>31)</sup>

## 2.4 Clinical periodontal examination

From 2009 to 2012, two trained examiners (JEH; Bo-Mi Yeo, Seoul National University) performed a periodontal examination. The kappa value for inter-examiner reliability was 0.822 for clinical attachment loss (CA loss). The examiners used periodontal probes (Hu-Friedy, Chicago, IL), and a headset flashlight (LED Lenser, Manchester, UK). The examination was performed while the pregnant woman rested on a portable unit-chair (Summit Chairs, Wiltshire, UK). Periodontal conditions were assessed by measuring periodontal CA loss that was determined at six sites (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual, and mesio-lingual surfaces) of all teeth except for the third molars and distal sites of the second molars. Periodontitis was defined as two or more interproximal sites with CA loss ≥ 4 mm that were not on

the same tooth.<sup>32)</sup> The subjects with periodontitis were divided into generalized and localized periodontitis. Generalized periodontitis was defined as four or more interproximal sites with CA loss  $\geq$  4.0 mm not on the same tooth, and localized periodontitis was defined as two or three interproximal sites with CA loss  $\geq$  4.0 mm not on the same tooth.<sup>33)</sup>

## 2.5 Statistical analysis

The data was analyzed with SPSS statistical software version 21.0 (SPSS, Chicago, IL.). The chi-square test for categorical variables and analysis of variance (ANOVA) for continuous variables were used to compare explanatory variables of the underweight, normal weight and overweight and obese groups of subjects. The explanatory variables consisted of age, obstetric information, health behaviors before pregnancy, and oral health behaviors and status. Multivariate logistic regression analyses were applied to examine the relationships between pre-pregnant BMI and periodontitis, adjusting for the effects of the covariates. To investigate that obese pregnant women have increased the risk according to the extent of periodontitis, additional multivariate logistic regression analyses were performed by dividing into two groups: generalized

periodontitis and localized periodontitis. An entering procedure for the five models was used to investigate the effects of selected cofounders. Model 1 was adjusted only for age which was adjusted in all the five models. Additionally, the models were adjusted for obstetric information (age at first delivery and parity, Model 2), health behaviors (smoking before pregnancy, weekly drinking before pregnancy, and weekly exercise before pregnancy, Model 3), and oral health behaviors (use of floss or interdental brush and scaling within one year prior to pregnancy, Model 4). Finally, all covariates were adjusted for in Model 5 (age, age at first delivery and parity, smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy, floss or interdental brush use and scaling within one year prior to pregnancy). Statistical significance was determined at  $P < 0.05$ .

### 3. Results

Table 1, 2, 3 shows characteristics of the study subjects based on BMI categories. The univariate association between BMI and explanatory variables was confirmed by a chi-square test and an analysis of variance. The results indicated that age, age at first delivery, and periodontitis were significantly associated with BMI ( $P < 0.05$ ). Periodontitis was more prevalent in overweight and obese women ( $P < 0.001$ ), but the experience of scaling within one year prior to pregnancy was not significantly different between the groups.

Table 4 shows the significant association between BMI and periodontitis and Table 5, 6 shows the association with periodontal condition in the multivariate logistic regression models. Five logistic regression models were designed to adjust for covariates related to periodontitis, according to demographic and obstetric information, health behaviors before pregnancy, oral health behaviors, and dental care utilization. Classification into the overweight / obese category was found to be significantly associated with periodontitis in all of the models ( $P < 0.05$ ). After adjusting for important co-factors (Table 4, model 5), women who were overweight / obese before pregnancy were 4.6 times more likely to have

periodontitis than normal weight women. A dose-effect relationship was observed for this association when extent of the disease was taken into consideration (Table 5, 6). However, there was no association between periodontitis and underweight in other models.

Table 1. Distribution of age and obstetric information based on BMI\* (n=315)

Variables	BMI			P value <sup>†</sup>
	Underweight (n=53)	Normal (n=203)	Overweight and obese (n=59)	
Age (years)	32.11±3.15 (26-40)	33.10±3.55 (26-47)	34.20±4.21 (25-43)	0.010
Age at first delivery (years)	30.38±2.96 (25-40)	31.58±3.48 (24-41)	32.56±3.82 (25-43)	0.004
Parity				
None	23 (43.4)	94 (46.3)	26 (44.1)	0.907
Once or more	30 (56.6)	109 (53.7)	33 (55.9)	

Number (%) was presented except for age & age at first delivery.

Age & age at first delivery are presented as mean ± SD (range).

\*Body mass index = kg/m<sup>2</sup> (underweight, < 18.5 kg/m<sup>2</sup>; normal, 18.5 to 22.9 kg/m<sup>2</sup>; overweight and obese, ≥ 23 kg/m<sup>2</sup>)

<sup>†</sup>Determined from the chi-square test for categorical variables and analysis of variance for continuous variables.

Table 2. Distribution of general health condition and behavior variables based on BMI\* (n=315)

Variables	BMI			P value <sup>†</sup>
	Underweight (n=53)	Normal (n=203)	Overweight and obese (n=59)	
Smoking before pregnancy				
No	50 (94.3)	188 (92.6)	53 (89.8)	0.654
Yes	3 (5.7)	15 (7.4)	6 (10.2)	
Weekly drinking before pregnancy				
No	26 (49.1)	111 (54.7)	31 (52.5)	0.919
Less than once	19 (35.8)	70 (34.5)	21 (35.6)	
Once or more	8 (15.1)	22 (10.8)	7 (11.9)	
Weekly exercise before pregnancy				
No	34 (64.2)	132 (65.0)	30 (50.8)	0.279
1~2 times	15 (28.3)	47 (23.2)	20 (33.9)	
≥ 3 times	4 (7.5)	24 (11.8)	9 (15.3)	

\*Body mass index = kg/m<sup>2</sup> (underweight, < 18.5 kg/m<sup>2</sup>; normal, 18.5 to 22.9 kg/m<sup>2</sup>; overweight and obese, ≥ 23 kg/m<sup>2</sup>)

<sup>†</sup>Determined from the chi-square test for categorical variables.

**Table 3. Distribution of oral health condition and behavior variables based on BMI\* (n=315)**

Variables	BMI			P value <sup>†</sup>
	Underweight (n=53)	Normal (n=203)	Overweight and obese (n=59)	
Floss or interdental brush user				
Yes	19 (35.8)	71 (35.0)	19 (32.2)	0.905
No	34 (64.2)	132 (65.0)	40 (67.8)	
Scaling within 1 year before pregnancy				
Yes	21 (39.6)	65 (32.0)	19 (32.2)	0.567
No	32 (60.4)	138 (68.0)	40 (67.8)	
Periodontitis <sup>‡</sup>				
Yes	14 (26.4)	34 (16.7)	27 (45.8)	< 0.001
No	39 (73.6)	169 (83.3)	32 (54.2)	
Periodontal condition				
Generalized periodontitis <sup>§</sup>	5 (9.4)	14 (6.9)	13 (22.0)	< 0.001
Localized periodontitis <sup>  </sup>	9 (17.0)	20 (9.9)	14 (23.7)	
Healthy periodontium	39 (73.6)	169 (83.3)	32 (54.2)	

\*Body mass index = kg/m<sup>2</sup> (underweight, < 18.5 kg/m<sup>2</sup>; normal, 18.5 to 22.9 kg/m<sup>2</sup>; overweight and obese, ≥ 23 kg/m<sup>2</sup>)

<sup>†</sup>Determined from the chi-square test for categorical variables.

<sup>‡</sup>Periodontitis was defined as two or more interproximal sites with CA loss ≥ 4.0 mm not on the same tooth.

<sup>§</sup>Generalized periodontitis was defined as four or more with CA loss ≥ 4.0 mm not on the same tooth.

<sup>||</sup>Localized periodontitis was defined as two or three with CA loss ≥ 4.0 mm not on the same tooth.

**Table 4. Adjusted odds ratios (OR) and 95% confidence intervals (CI) of BMI\* for periodontitis† (n=315)**

Model	BMI	Adjusted OR	95% CI	P value‡
Model 1	Normal	Reference	-	-
	Underweight	1.85	0.90 - 3.79	0.094
	Overweight and obese	4.06	2.15 - 7.67	< 0.001
Model 2	Normal	Reference	-	-
	Underweight	1.85	0.90 - 3.81	0.096
	Overweight and obese	4.03	2.14 - 7.61	< 0.001
Model 3	Normal	Reference	-	-
	Underweight	1.80	0.86 - 3.79	0.121
	Overweight and obese	4.46	2.29 - 8.70	< 0.001
Model 4	Normal	Reference	-	-
	Underweight	1.83	0.88 - 3.80	0.106
	Overweight and obese	4.15	2.17 - 7.92	< 0.001
Model 5	Normal	Reference	-	-
	Underweight	1.82	0.85 - 3.89	0.125
	Overweight and obese	4.57	2.30 - 9.07	< 0.001

\*Body mass index = kg/m<sup>2</sup> (underweight, < 18.5 kg/m<sup>2</sup>; normal, 18.5 to 22.9 kg/m<sup>2</sup>; overweight and obese, ≥ 23 kg/m<sup>2</sup>)

†Periodontitis was defined as two or more interproximal sites with CA loss ≥ 4.0 mm not on the same tooth.

‡Determined from multivariate logistic regression analysis.

All the models were adjusted for age as a continuous variable.

Model 1 was adjusted for age.

Model 2 was adjusted for age and obstetric information (age at first delivery and parity).

Model 3 was adjusted for age and health behaviors (smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy).

Model 4 was adjusted for age and oral health behaviors & dental care utilization (use of floss or interdental brush and scaling within one year prior to pregnancy).

Model 5 was adjusted for age, age at first delivery and parity, smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy, floss or interdental brush use and scaling within one year prior to pregnancy.

**Table 5. Adjusted odds ratios (OR) and 95% confidence intervals (CI) of BMI\* for localized periodontitis† (n=315)**

Model	BMI	Adjusted OR	95% CI	<i>P</i> value‡
Model 1	Normal	Reference	-	-
	Underweight	2.00	0.85 - 4.74	0.114
	Overweight and obese	2.67	1.24 - 5.74	0.012
Model 2	Normal	Reference	-	-
	Underweight	2.08	0.87 - 4.98	0.099
	Overweight and obese	2.64	1.22 - 5.68	0.013
Model 3	Normal	Reference	-	-
	Underweight	1.91	0.78 - 4.66	0.154
	Overweight and obese	3.06	1.36 - 6.86	0.007
Model 4	Normal	Reference	-	-
	Underweight	1.92	0.80 - 4.61	0.144
	Overweight and obese	2.67	1.23 - 5.79	0.013
Model 5	Normal	Reference	-	-
	Underweight	1.98	0.80 - 4.94	0.141
	Overweight and obese	3.09	1.34 - 7.09	0.008

\*Body mass index = kg/m<sup>2</sup> (underweight, < 18.5 kg/m<sup>2</sup>; normal, 18.5 to 22.9 kg/m<sup>2</sup>; overweight and obese, ≥ 23 kg/m<sup>2</sup>)

†Localized periodontitis was defined as two or three with CA loss ≥ 4.0 mm not on the same tooth.

‡Determined from multivariate logistic regression analysis.

All the models were adjusted for age as a continuous variable.

Model 1 was adjusted for age.

Model 2 was adjusted for age and obstetric information (age at first delivery and parity).

Model 3 was adjusted for age and health behaviors (smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy).

Model 4 was adjusted for age and oral health behaviors & dental care utilization (use of floss or interdental brush and scaling within one year prior to pregnancy).

Model 5 was adjusted for age, age at first delivery and parity, smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy, floss or interdental brush use and scaling within one year prior to pregnancy.

**Table 6. Adjusted odds ratios (OR) and 95% confidence intervals (CI) of BMI\* for generalized periodontitis† (n=315)**

Model	BMI	Adjusted OR	95% CI	<i>P</i> value‡
Model 1	Normal	Reference	-	-
	Underweight	1.38	0.47 - 4.05	0.554
	Overweight and obese	3.89	1.70 - 8.91	0.001
Model 2	Normal	Reference	-	-
	Underweight	1.32	0.45 - 3.90	0.611
	Overweight and obese	3.95	1.72 - 9.08	0.001
Model 3	Normal	Reference	-	-
	Underweight	1.36	0.46 - 4.02	0.581
	Overweight and obese	3.64	1.56 - 8.49	0.003
Model 4	Normal	Reference	-	-
	Underweight	1.40	0.48 - 4.10	0.542
	Overweight and obese	3.87	1.69 - 8.90	0.001
Model 5	Normal	Reference	-	-
	Underweight	1.35	0.45 - 4.02	0.594
	Overweight and obese	3.65	1.55 - 8.58	0.003

\*Body mass index = kg/m<sup>2</sup> (underweight, < 18.5 kg/m<sup>2</sup>; normal, 18.5 to 22.9 kg/m<sup>2</sup>; overweight and obese, ≥ 23 kg/m<sup>2</sup>)

†Generalized periodontitis was defined as four or more with CA loss ≥ 4.0 mm not on the same tooth.

‡Determined from multivariate logistic regression analysis.

All the models were adjusted for age as a continuous variable.

Model 1 was adjusted for age.

Model 2 was adjusted for age and obstetric information (age at first delivery and parity).

Model 3 was adjusted for age and health behaviors (smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy).

Model 4 was adjusted for age and oral health behaviors & dental care utilization (use of floss or interdental brush and scaling within one year prior to pregnancy).

Model 5 was adjusted for age, age at first delivery and parity, smoking before pregnancy, weekly drinking before pregnancy, weekly exercise before pregnancy, floss or interdental brush use and scaling within one year prior to pregnancy.

## 4. Discussion

This study was conducted to evaluate the association between overweight / obesity prior to pregnancy and periodontitis during pregnancy, which could be related to adverse effects such as a preterm birth, a low birth weight, and pre-eclampsia in pregnant women.

In this study, an association between overweight / obesity and periodontitis was revealed after adjusting for the demographic and obstetric information, health behaviors before pregnancy, and oral health behaviors and status. The results indicated that overweight and obese people had significantly higher ORs for periodontitis in all multivariate logistic regression models. These results are consistent with previous findings, and interestingly, pregnant women in this study showed the stronger association than non-pregnant women in most previous studies.

Saito et al.<sup>15)</sup> conducted a survey of 584 women between 40 and 79 years of age in Japan. They found that obesity (defined as  $25.0 \text{ kg/m}^2 \leq \text{BMI} \leq 46.7 \text{ kg/m}^2$ ) was associated with deep pockets in Japanese women, with OR of 4.3 according to BMI levels, even after adjusting for an oral glucose tolerance test. Dalla Vecchia et al.<sup>13)</sup> performed a survey of 706 subjects 30 to 65 years of age

from south Brazil. They reported that obese females (defined as BMI  $\geq 30$  kg/m<sup>2</sup>) were significantly more likely (OR = 2.1) to have periodontitis than normal weight females, after adjusting for demographic, behavioral, and other variables. Pataro et al.<sup>17)</sup> conducted a survey of 594 women between 18 to 65 years of age in Brazil. They showed that obese and overweight women (defined as BMI  $\geq 30$  kg/m<sup>2</sup>) exhibited statistically significant differences with OR of 1.17 to 1.89 according to BMI levels in periodontitis when compared to women with a normal BMI, with adjustment for age, years of education, marital status, smoking, diabetes, hypertension, and dyslipidemia. In this study, overweight and obese women had the significant association (OR = 4.03 to 4.57) with periodontitis in all multivariate logistic regression models. According to the extent of periodontitis, in all models, the association between BMI and generalized periodontitis (OR = 3.64 to 3.98) was stronger than that with localized periodontitis (OR = 2.64 to 3.09). Compared to the results of previous studies focused on women, the stronger association between overweight / obesity and periodontitis was found in this study.

Recent studies have indicated that adipose tissue is an important organ that secretes numerous immune-modulatory factors and plays a major role in regulating metabolic and vascular biology.<sup>22,34,35)</sup> Adipose cells, which include adipocytes, preadipocytes, and macrophages, secrete more than 50 bioactive molecules, known

collectively as adipokines.<sup>22,36)</sup> Adipokines play a number of different roles as hormone-like proteins, classical cytokines, proteins involved in vascular hemostasis, promoters of angiogenesis, and acute-phase respondents.<sup>32,37)</sup> These appear to be directly related to periodontal disease,<sup>21)</sup> and may directly injure periodontal tissue.<sup>20)</sup>

In addition, pregnancy may increase the host's susceptibility to a systemic inflammation by pregnancy-related hormonal influences on the immune system.<sup>26,27)</sup> An increase in estrogen and progesterone levels occurs during pregnancy, and it may play a role in increasing the severity of pregnancy gingivitis,<sup>38)</sup> with increases in probing depth and bleeding on probing.

Therefore, obesity and pregnancy may generate a synergistic effect on the occurrence and progression of periodontal disease. Thus, obese women before pregnancy could have the higher risk of periodontitis during pregnancy than normal weight women.

Periodontal disease during pregnancy could be a risk factor for adverse pregnancy outcomes.<sup>39-44)</sup> The association between maternal periodontal health and adverse pregnancy outcomes has been confirmed in several studies. Offenbacher et al.<sup>45)</sup> suggested that feasible mechanisms between periodontal inflammation and poor fetal growth might include translocation of periodontal pathogens, inflammatory mediators and the bacterial products such as

lipopolysaccharides, to the fetoplacental unit. Boggess et al.<sup>40)</sup> also suggested that women with active periodontal disease during pregnancy may have translocation of periopathogenic bacteria to the uteroplacental unit, which ultimately damages the placenta and can cause preeclampsia.

In this study, BMI was used to define overweight and obese participants. Body fat is most commonly estimated by using a formula that combines weight and height.<sup>46)</sup> The formula is based on the assumption that most of the variation in weight for people that are the same height is due to mass from fat. While BMI does not distinguish fat mass from lean mass,<sup>46)</sup> the BMI is the formula that is most frequently used in epidemiological studies.<sup>46)</sup>

There were several limitations to this study. As the subjects recruited from one big hospital in this study could not represent Korean pregnant women, the selection bias might not be excluded in this study. The researchers were unable to directly measure BMI before pregnancy, and instead, the patients were asked to respond to a questionnaire about weight and height prior to their pregnancy, which was obtained during a face-to-face interview. In addition, overweight and obesity were combined into a single category for analysis because of the small number of obese pregnant women. The cross-sectional design of this study was also a limitation because, based on the design, it was not possible to identify the causal relationship between periodontitis and

overweight / obesity. Also, this study used only measurements of CA loss to reflect periodontitis without probing depth. As CA loss could accompany non-inflammatory gingival recession, use of CA loss as a periodontal parameter might overestimate the periodontal inflammation. However, as pregnant women having gingival recession were few due to young age, the overestimation would be little in this study. Further study needs to measure periodontitis using CA loss and probing depth, including other factors such as microbiological factors (*i.e.* gingival crevicular fluid).

However, to our knowledge, this is the first study that investigated the association between periodontitis and overweight / obesity in pregnant women. Further studies are needed that can assess the synergistic effect of obesity and periodontal disease on adverse pregnancy outcomes.

## 5. Conclusions

The purpose of this study was to investigate whether overweight and obesity prior to pregnancy is associated with periodontitis during pregnancy. In conclusion, the results of this study indicate that overweight and obesity prior to pregnancy can be associated with periodontitis during pregnancy.

1. After adjusting for age, obstetric information, health behaviors before pregnancy, and oral health behaviors and status, women who were overweight / obese before pregnancy were 4.6 times more likely to have periodontitis than normal weight women (95% CI: 2.30 – 9.07).
2. After adjusting for age, obstetric information, health behaviors before pregnancy, and oral health behaviors and status, a dose-effect relationship was observed for this association when extent of the disease was taken into consideration.

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국문초록

# 임신 중기 임부의 비만과 치주염 간 연관성

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이 효 진

비만은 체내에 지방조직이 과다한 상태를 말하며, 전세계적으로 유병률이 높고, 여러 전신질환과도 연관성이 있으므로 예방 및 관리가 필요한 주요 건강문제 중 하나이다. 비만은 체내 대사작용 및 면역작용에 영향을 미칠 수 있고, 치주질환에 대한 숙주의 감수성을 높일 수 있다. 비만과 치주염 간 연관성은 많은 연구들에서 보고되어 왔고, 일반적으로 남성보다 여성에서 더 높은 연관성을 나타내고 있다. 또한, 임신기에는 임신 관련 호르몬의 영향으로 전신 염증상태에 대한 숙주의 감수성이 높아질 수 있다. 이에 본 연구에서는 임신 중기 임부를 대상으로 임신 전 과체중 및 비만과 임신 중 치주염 간 연관성에 대해 알아보하고자 한다.

본 연구는 2009년 3월부터 2012년 12월까지의 연구기간 동안 서울대학교 병원 산과에 내원한 제태연령 21-24주 임부 중에서 본 연구에 대한 설명을 듣고, 연구 참여에 동의한 임부를 대상으로 하였다. 본 연구에 참여한 임부 315명을 대상으로 자기기입 설문조사와 치주조직검사 및 치면열구액 채취를 수행하였다.

임신 전 흡연 및 음주경험, 임신 전의 운동과 같은 건강관리행태와 치실 및 치간솔 사용여부, 임신 전 1년 이내의 치면세마 경험과 같은 구강건강관리행태는 자기기입 설문조사를 통해 조사되었고, 산과관련정보와 전신질환정보는 서울대학교 병원 산과의 외래기록을 통해 조사되었다. 임신 전 과체중 및 비만은 설문조사를 통해 얻어진 임신 전 체중과 신장을 바탕으로 신체질량지수를 산출하여 대한비만학회(KSSO)와 WHO Expert Consultation에 의해 제안된 기준에 따라 신체질량지수가  $23 \text{ kg/m}^2$  이상인 경우로 정의하였다(저체중 <  $18.5 \text{ kg/m}^2$ ,  $18.5 \text{ kg/m}^2 \leq$  정상체중  $\leq 22.9 \text{ kg/m}^2$ ). 치주조직검사는 교육훈련을 받은 검사자 2인이 시행하였고, 제3대구치와 제2대구치의 원심부분을 제외한 치아의 근심협측, 중앙협측, 원심협측, 원심설측, 중앙설측, 근심설측의 여섯 부위에 대하여 치주탐침(University of North Carolina No. 15 probe, Hu-Friedy, Chicago, IL, USA)을 이용하여 임상적 치주조직 부착소실을 평가하였다. 치주염은 임상적 치주조직 부착소실이 4.0 mm 이상인 치아가 독립적으로 2개 이상인 경우로 정의하였고, 치주염의 이환 정도에 따라 임상적 치주조직 부착소실이 4.0 mm 이상인 치아가 독립적으로 2개 또는 3개인 국소적 치주염(localized periodontitis)과 4개 이상인 전반적 치주염(generalized periodontitis)으로 분류하였다.

과체중 및 비만과 치주염 간 연관성을 분석하기 위하여 다변량

로지스틱 회귀분석을 시행하였고, 최종 모형에서의 공변량은 입력방법(entering procedure)에 의하여 연령, 산과관련정보(첫 출산 연령, 출산경력), 건강관리행태(임신 전 흡연, 임신 전 음주, 임신 전 운동), 구강건강관리행태(치실 및 치간솔 사용, 임신 전 1년 이내 치면세마) 등의 변수들이 고려되었다. 모든 자료는 전산으로 입력하였고, SPSS version 21.0 (SPSS Inc., Chicago, IL, USA)을 이용하여 분석하였다.

임신 중기 임부 315명을 대상으로 임신 전 과체중 및 비만과 치주염 간 연관성을 조사한 결과, 다음과 같은 결과를 얻었다.

1. 임신 전 과체중 및 비만인 임부는 정상 체중의 임부에 비해 치주염의 위험이 약 4.6배 높게 나타났다(95% 신뢰구간: 2.30 - 9.07).
2. 치주염의 이환 정도에 따라 전반적 치주염과 과체중 및 비만 간 연관성(오즈비: 3.65, 95% 신뢰구간: 1.55 - 8.58)은 국소적 치주염과의 연관성(오즈비: 3.09, 95% 신뢰구간: 1.34 - 7.09)보다 높게 나타났다.

결론적으로, 임신 전 과체중 및 비만은 임신기간 중 치주염의 위험을 높일 수 있고, 이는 용량-효과 관계(a dose-effect relationship)를 가지는 것으로 조사되었다.

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**주요어** : 임신, 과체중, 비만, 신체질량지수, 치주염

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