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Periodontal status and associated risk factors among childbearing age women in Cixi City of China*

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Abstract: Objective: To investigate the periodontal status and associated risk factors among women of childbearing age to increase the awareness of oral health. Methods: The study was conducted on childbearing age women in Cixi, a city in Zhejiang Province in the southeast of China. A total of 754 women participated in periodontal examination while receiving prenatal care. Data of the women were collected from the Cixi Family Planning Commission and during an interview. Clinical periodontal indices, such as bleeding on probing (BOP), probing depth (PD), and clinical attachment level (CAL) were measured during the examination. Statistical analysis on subject-based data was performed. Results: The prevalence of periodontal disease among childbearing age women in Cixi was high (84.7%). A significant association was found between the disease and educational level, pregnancy, taking oral contraceptives, stress, alcohol consumption, overweight, dental visit, and teeth brushing (P<0.05). Women who suffered periodontal disease showed deep PD, obvious BOP, and clinical attachment loss. Among this population, pregnancy was closely associated with higher BOP percentage; teeth brushing no more than once per day or brushing for less than 1 min (P<0.001) after adjusting for age and stress. Conclusions: The periodontal status of childbearing age women in Cixi needs to be improved urgently. Attention towards the periodontal health should be warranted, especially for those in special statuses and with poor awareness.

Key words: Periodontal status, Childbearing age women, Risk factors, Pregnancy
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1 Introduction

Periodontal disease is a chronic inflammatory disease with a prevalence varying between 10% and 90% among adult population worldwide, and in China the occurrence is nearly up to 90% in adults (Wang *et al*., 2002; Petersen and Ogawa, 2005; Pihlstrom *et al*., 2005). Furthermore, its proportion appears to increase among women with childbearing age (Xiong *et al*., 2007).

Within the last two decades, a large number of cross-sectional, case-control, and cohort observational studies were carried out to investigate periodontal disease as a risk factor for adverse pregnancy outcomes (Arteaga-Guerra *et al*., 2010), which involved miscarriage, preeclampsia, preterm birth (PTB), low birth weight (LBW), and/or preterm low birth weight (PLBW) (Cruz *et al*., 2009). Results of these studies presented conflicting findings. Most studies reported positive association (Dortbudak *et al*., 2005; Pitiphat *et al*., 2008; Jeffcoat *et al*., 2011), while the researches reporting no significant association took up a small portion (Mitchell-Lewis *et al*., 2001; Noack *et al*., 2005).

The classical theory of 'focal infection'

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speculated that oral foci of infection might be a contributing factor in triggering systemic inflammatory response. Investigators hypothesized that hematogenous translocation of periodontal bacteria and their products or pro-inflammatory mediators from sites of periodontal infection into the fetal membranes, placenta, and amniotic cavity would induce pathological processes that could result in adverse outcomes (Clothier *et al*., 2007). It was reported that among pregnant women, periodontitis and/or gingivitis are the common concomitant clinical conditions (Moss *et al*., 2005). Approximately 40% of pregnant women suffered from periodontal disease (Lieff *et al*., 2004). Therefore, the exacerbation and remission of periodontal disease during the period of pregnancy may pose unpredictable pregnancy outcomes.

As known, the presence of dental plaque, which represents poor oral hygiene in clinic, is one of the main risk factors for periodontal disease. In addition, it is demonstrated that socioeconomic status, educational level, race, unhealthy lifestyles (such as tobacco use, excessive alcohol consumption, and mental stress), malnutrition, and other systemic disease conditions may have significant effects on risk of developing periodontal disease (Moss *et al*., 2005; Pihlstrom *et al*., 2005). For childbearing age women, especially during pregnancy, fluctuation of hormones also plays an important role (Dasanayake *et al*., 2008). Therefore, studying the relationship between periodontal disease and general condition from the perspective of periodontal medicine would make more sense.

In previous reports (Lieff *et al*., 2004; Offenbacher *et al*., 2009), sampling was limited to pregnant women, but the population of childbearing age women did not draw enough attention. Besides, the majority of studies used community periodontal index (CPI) to describe periodontal status. CPI, as one of the methods for evaluating the prevalence of periodontal disease, had been shown that it could underestimate the true values (Arteaga-Guerra *et al*., 2010). Therefore, examining six sites of each tooth in a full-mouth scale is necessary, which would make clear understanding of the prevalence of periodontal disease in a particular population.

As an independent risk factor for adverse pregnancy outcomes, periodontal disease is preventable. Therefore, improving periodontal status before pregnancy in order to reduce the occurrence of adverse pregnancy outcomes would be of great importance for public health. And understanding the characteristic of periodontal status among women with childbearing age would play an important role in developing health strategies.

In this study, it was hypothesized that the prevalence of periodontal disease in childbearing age women is influenced by individual's social-economic status, and potential risk factors associated with pregnancy might be involved in development of poor periodontal status. So questionnaire was developed to explore the risk factors, and full-mouth periodontal examination was performed to investigate the periodontal status in childbearing age women, in order to provide the basis for prevention and research of periodontal disease among this special population.

2 Materials and methods

2.1 Selection of subjects

The study population consisted of childbearing age women from Cixi (a city in the southeast of China, Zhejiang Province), who received uniform prenatal care in the Cixi Family Planning Commission. A total of 1074 volunteers aged 20–39 were enrolled in the study after giving informed verbal consent. And 791 of them completed the questionnaires and agreed to receive further periodontal examination. Exclusion criteria were: hypertension, diabetes, genito-urinary system diseases, blood diseases, rheumatoid arthritis, and long-term medication (antibiotics, hormone drugs, antiepileptic drugs, calcium channel blockers, immunosuppressants, etc.). Cixi Oral Guidance Center and Family Planning Commission approved this study.

2.2 Collection of demographic, socio-economic, and life style data

Based on the known risk factors, information was gathered from the volunteer's medical records and a personal interview before the periodontal examination. And the following data were recorded for each woman: socio-demographic (name, age, height, body weight, and birthplace), the socio-economic status (annual household income, educational level), adverse habits (smoking, alcohol, and oral contraceptives consumption). In the questionnaire, smoking was recorded as the number of cigarettes consumed

per day, and alcohol consumption was evaluated as the number of drink per week. The above two questions referred to pre-pregnancy period for pregnant subjects. The smoking habit was divided into two categories: yes (≥1 cigarette per day), no (never smoked or former smoker). Alcohol intake was divided into two categories: yes (≥1 drink/week), no (never drunk or former drinker). Also, stress level was stratified into four categories: no (no stress completely), mild (slightly stress, causing a chaotic emotions), moderate (stress leading to physical discomfort, e.g., fatigue), and high stress (stress causing systemic complications, affecting normal life and work). Body mass index (BMI) was defined as weight in kilograms divided by the square height in meters and classified into the following BMI groups: underweight (≤18.5 kg/m^2), normal (18.5–25.0 kg/m^2), overweight and obese (≥25.0 kg/m^2).

2.3 Measurement of periodontal status

Clinical periodontal examination was performed on all the participants by a calibrated CP-10 periodontal probe (Hu-Friedy, USA). The measurements were carried out at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual, disto-lingual), except the third molars.

Bleeding on probing (BOP), probing depth (PD), and clinical attachment level (CAL) were chosen to measure periodontal status. BOP was evaluated when probing into the sulcus, six sites per tooth, and recorded as the percentage of bleeding sites in the total tooth sites. PD was measured in millimeters from the gingival margin to the most apical portion of the pocket. CAL was calculated in millimeters from the cemento-enamel junction to the most apical part of the pocket.

In order to reduce the inter- and intra-examiner variability, the whole examination was taken by two dentists who were trained and calibrated on fifteen volunteers by a professional periodontist prior to the commencement of the study. Percentage agreements for PD, CAL within 1 mm and BOP ranged from 79.5% to 100%. And Kappa test, which was used to assess the inter- and intra-examiner reliability, was ≥0.73, respectively.

2.4 Criteria for periodontal diagnosis

There is no universally accepted criterion for periodontal disease at the patient level. However, in most studies on periodontal disease, definitions that combined PD, CAL, and/or BOP over a certain threshold (e.g., ≥3 mm) have been used (Manau *et al*., 2008). In this study, periodontitis was defined as the presence of two or more teeth showing one or more sites with PD≥4 mm and CAL≥3 mm at the same time. Women showing more than 25% sites with BOP, without PD≥4 mm or CAL≥3 mm were diagnosed as gingivitis or mild periodontitis. Individuals who had either periodontitis or gingivitis as mentioned above were all diagnosed as having periodontal disease.

2.5 Statistical analysis

Analysis was performed to compare the characteristics of the study population between the periodontally healthy and diseased group. Chi-square tests or Fisher's exact tests were applied in categorical variables (e.g., demographic data), and partition of Chi-square tests was applied for further study. To assess the association between potential risk factors and periodontal indices, multivariable logistic regression was conducted. In the models, 'two or more sites with PD≥4 mm', 'two or more sites with CAL≥3 mm', and 'more than 25% sites with BOP' were introduced as dependent variables. The general condition and health behaviors were considered as independent variables. Among periodontally diseased population, Student's *t*-tests were used to compare continuous variables (e.g., mean number of sites with PD, CAL, and BOP). Moreover, the influence of pregnancy on periodontal status and oral health habits was further evaluated through multivariable logistic regression. Pregnancy was the only independent variables, and oral health behaviors were the additional dependent variables. The adjusted odds ratio (OR) and 95% confidence intervals (CI) were calculated. Data were analyzed using SPSS 16.0 for Windows. Statistical significance was defined as $P<0.05$.

3 Results

3.1 Demographic characteristics and general periodontal status of the study population

Of the 791 women agreeing to participate in periodontal examination, 37 (4.7%) were excluded for suffering from systemic diseases that were

associated with periodontal disease. Table 1 summarized the basic characteristics of the samples and the general results of periodontal examination. All the women were of the Han origin and had long-term residency in Cixi. According to the periodontal examination, only 115 (15.3%) individuals were periodontally healthy and 639 (84.7%) suffered from periodontal disease. The majority of the volunteers' ages ranged from 20 to 25 years (50.9%), with a mean±standard deviation (SD) of (25.9±2.3) and (26.2±3.6) years, respectively for periodontally healthy and diseased groups. The age distribution was normal, with no significant difference between the two groups (P=0.628). Among these subjects, 703 (93.2%) were married, 176 (23.3%) were pregnant, and 226 (30.0%) had only finished primary education. With respect to the data above, there was significant difference between the periodontally healthy and diseased groups (P<0.01). As for income level and cigarette consumption, no statistical difference was shown between the two groups (P>0.05). In the whole population, 36 (4.8%) smoked occasionally and most of them (3.4%) consumed ≤3 cigarettes per day. The percentage of individuals with periodontal disease was statistically higher in married and pregnant women, as well as in low educational level group (P<0.005).

3.2 Association between potential risk factors and periodontal indices

According to Nabet *et al*. (2010)'s report, two or more sites with PD≥4 mm and CAL≥3 mm were correlated with periodontal disease (Wimmer and Pihlstrom, 2008), while more than 25% sites with BOP indicated inflammation of the gingiva (Lopez *et al*., 2002). Therefore, based on the results of periodontal examination, we developed three multivariable logistic regression models of the potential clinical exposures and poor periodontal status with adjustment for age in Table 2. We analyzed the association between periodontal indices and risk factors in the following three models: two or more sites with PD≥4 mm (n=628), two or more sites with CAL≥3 mm (n=586), and more than 25% sites with BOP (n=639). According to the criteria for periodontal disease in this study, the samples included in each model

Table 1 Demographic characteristics and periodontal examination of the study population (n=754)

Variable	Periodontally healthy*	Periodontally diseased*	χ^2 test P value
Age (year)			
20–25	65 (56.5%)	319 (49.9%)	0.285
26–29	29 (25.2%)	202 (31.6%)	
30–35	13 (11.3%)	89 (13.9%)	
35–39	8 (7.0%)	29 (4.5%)	
Marital status			
Married	97 (84.3%)	606 (94.8%)	<0.001**
Unmarried	18 (15.7%)	33 (5.2%)	
In pregnancy			
Yes	15 (13.0%)	161 (25.2%)	0.005**
No	100 (87.0%)	478 (74.8%)	
Educational level[a]			<0.001**
Primary	15 (13.0%)	211 (33.0%)	<0.001**
Secondary	62 (53.9%)	331 (51.8%)	<0.001**
Higher	38 (33.0%)	97 (15.2%)	
Annual household income			0.152
≤60000	19 (16.5%)	116 (18.2%)	
60000–150000	68 (59.1%)	317 (49.6%)	
≥150000	28 (24.3%)	206 (32.2%)	
Cigarette consumption			
No	113 (98.3%)	605 (94.7%)	0.216
≤3/d	2 (1.7%)	24 (3.8%)	
>3/d	0 (0.0%)	10 (1.6%)	

[a] Educational level: primary, less than primary school vs. secondary and higher educational level; secondary: junior and senior high school/secondary school vs. higher educational level; Higher: college and above. **P<0.01, compared to unmarried, nonpregnant group; * Values are expressed as n (%), total number of periodontally healthy subjects is 115 and of periodontally diseased patients is 639

Table 2 Multivariable logistic regression for associations between potential risk factors and periodontal status

Variable	Two or more sites with PD≥4 mm		Two or more sites with CAL≥3 mm		More than 25% sites with BOP	
	Adjusted OR (95% CI)	*P* value	Adjusted OR (95% CI)	*P* value	Adjusted OR (95% CI)	*P* value
Pregnancy	1.13 (0.75–1.84)	0.265	0.17 (0.09–0.44)	0.731	3.24 (1.98–5.15)	0.001**
Taking oral contraceptives before pregnancy	2.35 (0.38–3.44)	0.316	1.03 (0.52–2.18)	0.309	3.29 (1.68–4.71)	0.015*
Smoking	0.55 (0.24–1.31)	0.371	0.76 (0.12–1.43)	0.334	0.89 (0.30–1.64)	0.233
Alcohol	2.57 (1.52–2.97)	0.024*	2.44 (2.02–3.87)	0.035*	3.01 (1.73–5.26)	0.029*
Stress (high[a])	4.53 (2.62–6.61)	0.002**	4.64 (2.72–7.22)	0.013*	5.32 (3.83–8.01)	<0.001**
Body mass index [b]						
Underweight (≤18.5 kg/m^2)[c]	0.68 (0.29–1.32)	0.241	0.56 (0.33–0.99)	0.411	0.74 (0.41–1.19)	0.392
Overweight to obesity (≥25 kg/m^2)[c]	3.86 (1.65–6.57)	0.022*	3.89 (2.13–8.01)	0.011*	4.59 (1.92–7.94)	0.002**
Irregular dental visit[d]	3.12 (1.67–4.47)	0.003**	3.43 (1.99–4.81)	0.007**	4.36 (3.17–7.21)	<0.001**
Brushing methods						
Back and forth[e]	4.14 (2.16–7.11)	0.004**	6.29 (4.48–10.73)	0.006**	5.23 (3.51–9.59)	0.005**
Up and down[e]	2.95 (2.04–4.18)	0.012*	1.87 (1.01–3.86)	0.036*	3.58 (2.34–7.36)	0.041*
Brushing frequency						
0 time per day [f]	5.12 (3.09–8.23)	0.002**	4.36 (2.95–6.89)	0.003**	6.37 (4.76–9.33)	<0.001**
1 time per day [f]	1.38 (0.76–1.61)	0.325	0.79 (0.36–1.07)	0.274	2.05 (1.35–2.73)	0.023*
Time for brushing						
<1 min [g]	4.56 (2.19–8.55)	0.001**	2.12 (1.71–3.26)	0.004**	7.43 (5.69–12.32)	<0.001**
1–3 min [g]	1.26 (0.48–1.64)	0.197	0.63 (0.25–0.95)	0.431	1.54 (0.81–1.82)	0.079

**P<0.01, *P<0.05, as versus the nonpregnant group, those who did not take oral contraceptives before pregnancy or those who never drunk or former drinker; OR adjusted for age. [a] Versus no, little, or moderate stress; [b] BMI before pregnancy for pregnant women; [c] Versus normal BMI between 18.5–25.0; [d] Irregular dental visit referring to those who visit dentist only when toothached; [e] Versus Roll method; [f] Versus '≥2'; [g] Versus '>3'

contained certain subjects considered as periodontally healthy but existing specific sites with abnormal periodontal index. It turned out that there was a significant interaction between alcohol consumption, stress, overweight, irregular dental visit (referring to those who only visit dentist when they had a toothache), false brushing method, never brushing teeth, brushing for less than 1 min, and PD, CAL, and BOP case groups. Although pregnancy and oral contraceptives consumption were not associated with PD and CAL, they both had significant association with BOP (P<0.05). The above data could be explained by the fact that pregnancy and taking oral contraceptives may exacerbate the inflammation of the gingiva, but could not promote the apical positioning of the junctional epithelium. Brushing once a day was only associated with BOP (P=0.023, OR: 2.05, 95% CI: 1.35–2.73), while spending 1–3 min on brushing did not affect any periodontal index. Furthermore, contrary to our expectation, no correlation could be found between smoking and all three indices (P≥0.05).

3.3 Influence of pregnancy on periodontal status and oral health habits in subjects with periodontal disease

In order to understand the role of pregnancy in periodontal disease more clearly, we selected the 639 periodontally diseased individuals, among which we

Table 3 Periodontal characteristics between the pregnant and nonpregnant women with periodontal disease (*n*=639)

Periodontal indices	Age (year)	PD (mm)	CAL (mm)	Percentage of sites with:		
				PD≥4 mm	CAL≥3 mm	BOP
Pregnant (*n*=161)	23.4±2.5	5.1±2.1	1.4±0.6	32.3±14.3	13.8±9.7	63.8±19.3
Nonpregnant (*n*=478)	27.1±4.0	5.4±2.5	3.7±1.1	34.0±16.2	29.3±14.3	54.2±21.9
t-test *P* value	0.016*	0.681	0.007**	0.732	0.005**	0.015*

** *P*<0.01, * *P*<0.05, compared between the pregnant and nonpregnant groups

compared the differences of periodontal status and oral health habits between the pregnant and nonpregnant women. The average age of the nonpregnant women was significantly older than that of the pregnant ones, with the mean age of (27.1±4.0) and (23.4±2.5) years, respectively (*P*=0.016). Compared to the non-pregnant women, the value and percentage of BOP positive sites in the pregnant ones was significantly higher, while the CAL level was lower (Table 3). However, there was no apparent difference in PD between the two groups (*P*>0.05). Therefore, based on the above results in Tables 2 and 3, we further assessed the influence of pregnancy on periodontal status and oral health habits in Table 4, to search the potential confounding factors. We chose the confirmed periodontal risk factors in Table 2. After careful analysis, we assumed that age and stress might be the two major confounding factors. Then, three multivariable logistic regression models were developed in Table 4 after adjusting for age and stress: two or more sites with PD≥4 mm (*n*=621), two or more sites with CAL≥3 mm (*n*=562), and more than 25% sites with BOP (*n*=639), and another three models in Table 4: teeth brushing ≤1 time/d (*n*=463), teeth brushing <1 min (*n*=294), and regular dental visit (*n*=78). The independent variable of all groups was pregnancy, but no association with abnormal PD, CAL, and regular dental visit groups. Teeth brushing turned out to be significantly associated with abnormal BOP, and pregnancy turned out to be significantly associated with abnormal BOP, teeth brushing no more than once per day, or brushing for less than 1 min (*P*<0.001), but not related with abnormal PD, CAL, and regular dental visit groups. This result indicated that among this Chinese population, pregnancy is closely related with periodontal tissue inflammation which might be the result of neglect of oral hygiene behavior.

Table 4 Multivariable logistic regression for the influence of pregnancy on periodontal status and oral health habits (*n*=639)

Variable	Adjusted OR[a] (95% CI)	*P* value
Periodontal status		
Two or more sites with PD≥4 mm (*n*=621)	1.07 (0.64–1.68)	0.283
Two or more sites with CAL≥3 mm (*n*=562)	0.22 (0.08–0.56)	0.842
More than 25% sites with BOP (*n*=639)	3.05 (1.77–5.09)	0.001**
Oral health habits		
Teeth brushing ≤1 time/d (*n*=463)	4.37 (2.03–8.53)	<0.001**
Time for brushing <1 min (*n*=294)	5.54 (2.96–10.05)	<0.001**
Regular dental visit (*n*=78)	0.59 (0.32–0.89)	0.963

** *P*<0.01, * *P*<0.05, compared to less than 25% sites with BOP, or bushing more than 1 time/d or more than 1 min per time; [a] OR adjusted for age and stress

4 Discussion

A high prevalence (84.7%) of periodontal disease was found among childbearing age women in Cixi. Women aged from 20–29 years made up the main part (81.5%) of population with periodontal disease. The majority of periodontally healthy subjects were with high educational level, or those who paid more attention to oral health and regular dental examination and/or treatment. According to this study, annual household income was not related with periodontal disease as shown in Table 1. It was also demonstrated that pregnancy was a risk factor for periodontal disease, which might be related with the fact that increased estrogen level enhances a woman's susceptibility to periodontal disease (Clothier *et al*., 2007). Since all the pregnant subjects recruited in this study were all married, so a large proportion of married

women were found to have periodontal problem compared with unmarried ones. According to previous studies, overweight and adverse behaviors, such as consumption of smoking and alcohol, were all risk factors contributing to development and progression of periodontal disease (Moss *et al*., 2005; Hugoson and Rolandsson, 2011). On the contrary, in this study cigarette consumption was not one of the risk factors. Among all the subjects in this study, the proportion of smoking population was very low (4.8%). Besides, only a few (10 out of 754) women smoked more than three cigarettes per day and no heavy smokers who had more than 20 cigarettes per day were found, which might account for the unusual result.

Further analysis on the association between potential risk factors and periodontal status showed that several factors were associated with periodontal indices, among which stress is a very important one. High level of stress that refers to stress causing systemic complications in this study and affecting normal life and work, was demonstrated to be correlated with PD, CAL, and BOP. Stress is mental, physical, or emotional response to events that cause mental tension, which is closely associated with work overload and uncontrollable situations in modern society (Arteaga-Guerra *et al*., 2010). Sateesh *et al*. (2010) reported that stress affected periodontal disease in the way of psycho-neuro-immunologic-endocrinologic changes, risk health behavior, or a combination of the both.

BMI, which is used to assess general body composition and as an indicator of underweight, overweight, and obesity, was classified into three groups according to the adult standard. It is postulated that overweight even obesity associated with an excessive diet of fatty acids or lipids could depress immune function and reduce blood flow to the periodontal tissues, and thus promote the development of periodontal disease (Amin, 2010; Pataro *et al*., 2012). Furthermore, it has been found that adverse effects of obesity on the periodontium may be mediated through pro-inflammatory cytokines and various other bioactive substances (Suvan *et al*., 2011; Gorman *et al*., 2012). In addition, overweight may enhance immunological, endocrinological or inflammatory disorders, which is probably the reason that obese ones tend to exhibit escalating poor periodontal condition relative to non-obese individuals (Morita *et al*., 2011).

False brushing method (e.g., horizontal or vertical brushing), inadequate brushing frequency or time would naturally lead to poor oral hygiene and periodontal destruction. People who visit dentist only when tooth ached often show worse periodontal status. Although the severe condition could be relieved to some extent, the destruction of periodontal tissue can hardly be recovered. In the present study, irregular dental visit had been identified as one of the critical risk factors. Unfortunately, women in pregnancy did not show strengthened awareness of the importance of regular dental examination. Therefore, it is essential to check the teeth regularly even if there were no symptoms.

During pregnancy, the increased level of estrogen and progesterone has a special effect on the periodontium, which would enhance the reaction to local stimulation and lead to the occurrence or increase of inflammation in gingiva. The inflammation in gingiva leads to the formation of false periodontal pockets with little or no attachment loss. And it is reported that taking oral contraceptives before pregnancy would facilitate the change (Clothier *et al*., 2007). Meanwhile, gingival tissue is prone to bleeding when probing due to the inflammation in an active phase (Radnai *et al*., 2004). So BOP might reflect the activity of disease to some extent. Our findings also indicated that pregnancy was significantly related with abnormal BOP but not with PD or CAL.

So far as we know, age is related to the progression of periodontal disease for accumulation of local and/or host contributing factors. Furthermore, stress had been identified as one of the major risk factors for periodontal disease. Besides, it plays an essential role in pregnancy (Dunkel Schetter, 2011). So age and stress were adjusted at the same time to find how pregnancy affects the periodontal status among the periodontally diseased population (Table 4). And the results further confirmed that pregnancy was related with abnormal BOP.

Teeth brushing, being the most important oral health behavior, is still prohibited during pregnancy for some people who hold the old Chinese superstition. And gestation reaction such as vomiting would make women to reduce the brushing frequency and time. As a result, poor oral hygiene leads to the occurrence and development of periodontal disease. Therefore, it is essential to correct the misleading

opinion and reinforce the consciousness of oral health behavior among this population.

Many studies have proposed periodontal treatment during pregnancy in order to reduce the incidence of adverse pregnancy outcomes (Davenport, 2004; Michalowicz *et al*., 2006; Macek, 2008). The previous randomized, controlled trials have illustrated that treatment consisting of scaling and root planing in pregnant women had greatly decreased the local stimuli. However, for periodontal disease and adverse pregnancy outcomes, some scholars considered the therapy could take effect, while others opposed (Offenbacher *et al*., 2009). Assuming that the treatment performed is successful in relieving inflammation, pregnancy itself is a risk for the onset and progression of periodontal disease. Besides, periodontal therapy may induce immune responses, which in turn influence pregnancy outcomes (Polyzos *et al*., 2010). Therefore, pre-pregnancy treatment and follow-up examination during pregnancy seem to be a much more appropriate and reasonable alternative.

5 Conclusions

In summary, the investigation in Cixi on the periodontal status among childbearing age women provided additional evidence regarding the oral health problem of such a special population. It remains important for health care workers to take special oral hygiene measures to increase the awareness of oral health and changing the present situation, especially for women who were not well-educated, pregnant, overweight, or in high level of stress. Furthermore, our results also support a specific drive to improve the periodontal health of childbearing age women as a potential means of avoiding adverse pregnancy outcomes.

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