

Prevalence and Risk Factors of Periodontal Disease among Pregnant Women in a Rural Area of China

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Abstract

Background

Periodontal disease is one of the most important common oral diseases contributing to the global burden of chronic disease. Systematic reviews have demonstrated that poor periodontal condition during pregnancy was significantly associated with adverse pregnancy outcomes such as preterm birth, low birth weight, preeclampsia, etc. Oral health care is often a neglected area in low- and middle- income countries, particularly in rural areas due to the limited health human resources and poor infrastructures resources. Very few studies have explored the risk factors of periodontal disease among pregnant women in rural areas of China.

Methods

A cross-sectional study was conducted among 648 women between 2 and 28 weeks of gestation at an antenatal clinic in Maternal and Child Health Hospital of Leping, Jiangxi Province, China. Periodontal Screening & Recording (PSR) was used to determine periodontal disease. Data on respondents' demographic characteristics, gestational age, regular oral health habits, and mental health condition were collected using a self-administered questionnaire.

Results

The prevalence of periodontal disease in pregnant women was 79.78% (95% *CI*: 76.7%~82.7%). Periodontal disease was significantly associated with increased maternal age (*aOR* = 1.13, 95% *CI*: 1.06~1.21, *P* < 0.001) and gum bleeding during tooth brushing (*aOR* = 3.76, 95% *CI*: 2.05~7.00, *P* < 0.001). The severity of periodontal disease advanced with the increased maternal age and gum bleeding during pregnancy.

Conclusions

Pregnant women with increased maternal age and gum bleeding during tooth brushing were at a higher risk of periodontal disease and needed to have the access to oral health care.

Background

Periodontal disease is one of the most important oral diseases contributing to the global burden of chronic disease [1-4]. Globally, more than 75% of adults have oral health problems, such as gingival bleeding, calculus, and shallow or deep periodontal pockets [1]. Moreover, 10% to 15% of the adults are with severe periodontal disease [1]. According to the findings of the 3rd National Oral Health Epidemiological in China, the prevalence of unhealthy periodontal conditions, including gingival bleeding, calculus or periodontal pockets no more than 3mm loss of attachment among Chinese adults was as high as 85% [5].

Systematic reviews have demonstrated that poor periodontal condition during pregnancy was significantly associated with adverse pregnancy outcomes such as preterm birth, low birth weight, preeclampsia, etc. [6-14].

Oral health care is often a neglected area in low- and middle- income countries, particularly in rural areas due to the limited human resources and poor infrastructures. In 2011, Chinese Ministry of Health released *Regulation of Maternal Health Care and Work Specification of Maternal Health Care*, introducing maternal oral health care into the framework of perinatal health care. However, the oral health care during prenatal care has not been universally provided, especially in underdeveloped rural areas. There is also very few information about oral health conditions and disorders among Chinese rural pregnant women. Studies have shown factors associated with periodontal disease among general population included the increased age, low educational level, poor economic status, tobacco use, psychological distress, and poor oral hygiene [15-20]. But very few studies have explored the risk factors of periodontal disease among pregnant women in rural areas of China.

To understand the prevalence of periodontal disease and the risk factors among pregnant women in rural areas of China, we analyze data from the baseline survey of a randomized clinical trial (RCT) in Leping, a rural area of China.

Methods

Participants and recruitment

This was the baseline survey of a RCT study which aimed to observe the effects of mouth rinse intervention during pregnancy on reducing the negative pregnancy outcomes such as Premature Rupture of Membranes (PRM), Gestational Diabetes Mellitus (GDM), and Pregnancy-induced Hypertension (PIH) et al [21]. The study was conducted in Maternal and Child Health Hospital of Leping, Jiangxi Province, China, a mid-income rural area with around 20% of the total income from agriculture. The hospital is the only maternal and child health care hospital in the county, with a total of 4,000 deliveries annually, accounting for nearly half of the total deliveries in the county. All pregnant women attending prenatal care visits and meeting the criteria were invited to participate in the study by research nurses [21].

The inclusion criteria of participants were as follows: (1) pregnant women who were at least 18 years old with gestational age less than 20 weeks; (2) having an educational level no less than grade 3 in primary school and with the basic ability to read and write; (3) having at least 20 teeth; (4) having no moderate or severe dental caries; (5) having no systemic disease, including severe cardiovascular disease, diabetes, hyperthyroidism, and/or other systemic diseases; (6) having no sexual transmitted disease; (7) willing to participate in the study and to sign the informed consent form.

Research methods and tools

Written informed consent was obtained from each eligible participant before they were provided with a free dental examination for screening periodontal disease. A self-administered questionnaire was distributed, checked and collected by nurses at the recruitment. Ethical approval to conduct this trial has been granted by the Institutional Review Board of School of Public Health, Fudan University, Shanghai, China (IRB# 2013-09-0462); and also by the Institutional Review Board of Tulane University, New Orleans, Louisiana, USA (IRB# 13-469160). The original RCT is registered with Chinese Clinical Trial Registry (#ChiCTR-TRC-13003768) [21].

The self-administered questionnaire mainly contained three sections. Section A was about respondents' demographic characteristics and health related information. Section B collected the information on women's routine oral health habits, including the frequency of daily tooth brushing, the duration of tooth brushing, the habit of rinsing mouth after meals or snacks, and the approach of brushing teeth. Each of four questions about oral health habits was graded with one score. Pregnant women received 0 for none appropriate to four appropriate for all. According to pre-pregnancy BMI, pregnant women were categorized into underweight (<18.5), normal and overweight/obesity (≥ 25). Section C mainly contained a Chinese version of Edinburgh postpartum depression scale (EPDS). It was a 10-item self-report instrument in which women were asked to rate how they had felt in the previous 7 days. EPDS serves as a 'gold standard' for the diagnosis of both Antepartum Depression and Postpartum Depression [22]. Each question of EPDS scores 0–3 and the total score ranges from 0 to 30 [22]. The increased EPDS scores indicates a higher possibility of antepartum depression.

Dental examination was performed on pregnant women using Periodontal Screening and Recording (PSR) [23]. PSR, developed by the American Academy of Periodontology, is a simple, safe, inexpensive and rapid screening tool for periodontal disease compared with the full mouth periodontal examination. During the examination, the mouth was divided into sextants. The dentist examined each sextant by using a ball tipped probe with a color-coded area 3.5mm to 5.5mm. During the examination, the dentist inserted the probe into the periodontal pocket, walked around the circumference of each tooth, observed the position of the color-coded band in relation to the gingival margin, and recorded the highest code of the sextant [23-25]. Measurements were recorded in a special box chart with 6 blanks to be filled with 6 codes scored 0-4. Code 0 means healthy periodontal conditions with no bleeding after gentle probing and no calculus or defective margins detected; Code 1 means gingival bleeding, which is with bleeding after gentle probing and no calculus or defective margins detected; Code 2 means gingival bleeding and calculus, which is detection of supragingival or subgingival calculus and/or defective margins; Code 3 means shallow periodontal pockets with a probing depth greater than 3.5mm and not more than 5.5mm, defined as Mild & Moderate Periodontal Disease; Code 4 means deep periodontal pockets with a probing depth greater than 5.5mm, also being defined as Severe Periodontal Disease[23]. Pregnant women were diagnosed with periodontal disease with at least one code higher than 2.

Statistical analyses

Univariate analyses were firstly applied to explore the factors associated with periodontal disease, gingival bleeding or calculus, and severe periodontal disease among pregnant women, respectively. Categorical variables were compared using Pearson χ^2 test or Fisher's exact test; Mann-Whitney U test was used for comparing distributions and trends for non-normal distributed data, and also for ordered categorical variables. Finally, multivariable logistic regression model was used to identify factors associated with periodontal conditions. Adjusted odds ratios (aOR) and 95% confidence interval (CI) were derived from the coefficients of the logistic models and their standard errors. The multiple linear regression model was used to test the trend for severity of periodontal disease among pregnant women and risk factors. The severity of periodontal disease was set as an ordinal variable, being coded from one to three representing healthy periodontium, mild/moderate periodontal disease, and severe periodontal disease, respectively. All statistical analyses were performed using SPSS software (SPSS for Windows version 21.0; SPSS Inc., Chicago, IL).

Results

A total of 648 pregnant women participated in the periodontal screening between November 2013 and September 2014. The mean age of pregnant women was 23 years old (ranging 18-44 years). Around 83% (536/648) of the participants had education of junior middle school or lower. Around 60% (411/648) of pregnant women were employed. Half of women (P_{25} to P_{75}) had monthly family income between 4,000 (600USD) and 6,000 RMB (900USD). The median gestational age at the recruitment was 14 weeks (range 4-20 weeks). The proportion of primiparae was 37% (240/648). Only 1% (6/648) pregnant women reported smoking. The median EPDS score was 11 (range 0-23). Around 1/4 (163/648) of the participants often had gum bleeding during tooth brushing. Nearly 50% (308/648) reported tooth brushing at least twice a day. Less than 30% (184/648) of women reported routine time of tooth brushing between 3 and 5 minutes. (Table 1)

The prevalence of periodontal disease during pregnant women was 79.8% (517/648, 95% CI: 76.7%~82.7%). Among 517 pregnant women with periodontal disease, 97% were with mild & moderate periodontal disease (500/517) and 3% with severe periodontal disease (17/517). Among 131 women who were not identified with periodontal disease (20.2%, 131/648), 92% (121/131) were found with gingival bleeding or calculus. Among all 648 pregnant women, only 1.5% (10/648) had healthy periodontal conditions. (Table 1)

The multivariate logistic regression analysis (Table 2) showed periodontal disease was significantly associated with increased maternal age (aOR = 1.13, 95% CI: 1.06~1.21, $P < 0.001$) and gum bleeding during tooth brushing (aOR = 3.76, 95% CI: 2.05~7.00, $P < 0.001$). Mild & moderate periodontal disease was found significantly associated with increased maternal age (aOR = 1.13, 95% CI: 1.06~1.21, $P < 0.001$), gum bleeding during tooth brushing (aOR = 3.65, 95% CI: 1.97~6.76, $P < 0.001$) and employment condition (aOR = 1.54, 95% CI: 1.01~2.36, $P = 0.046$). Compared to pregnant women without periodontal disease, those with severe periodontal disease had significantly higher rates of gum bleeding during tooth brushing (aOR = 15.87, 95% CI: 4.04~62.35, $P < 0.001$).

According to trend analysis using the multivariable linear regression, a significantly positive linear trend was found between the severity of periodontal morbidity and age, and the trend also was found between the severity and gum bleeding during tooth brushing (Table 3). The severity of periodontal disease advanced with increased ages and gum bleeding during tooth brushing.

Discussion

The study found that periodontal disease was very prevalent, with the prevalence of about 80% among pregnant women in rural China. Among women with periodontal disease, 97% were with mild & moderate periodontal disease and 3% with severe periodontal disease. The increased maternal age and gum bleeding during tooth brushing were associated with an increased risk of periodontal disease.

The prevalence of periodontal disease among rural pregnant women in our study was a bit higher compared with the pre-conception women in an urban area of China (73.9%, 95% *Ci*: 71.0%~76.6%). This might be due to the time of periodontal examination. Estrogen and progesterone, the main hormones during pregnancy, play a significant role in aggravating the periodontal disease during pregnancy. As the hormones are continuously produced by corpus luteum after the implantation of a fertilized ovum and to peak in the blood during the third trimester of pregnancy, the periodontal condition usually gets worse with the increased gestation age.

Compared with the other studies conducted among Chinese pregnant women in which the prevalence of gingivitis and periodontitis were showed from 25.5% to 74.8% among pregnant women, the prevalence of our study was higher. The locations of those studies, however, were from the tertiary hospitals in urban cities; whereas the participants in our study were from underdeveloped rural areas, with relatively lower education level and poorer oral health habit. Compared to the United States' prevalence rate (about 24% in adults 30 to 34 years age in NHANES 2009 and 2010), the high prevalence of periodontal disease among rural pregnant women may be due to the fact that oral health care is not well available in China, especially in those less developed areas.

Periodontal disease was considered to be associated with the increased age, overweight, obesity, poor oral hygiene, stressful psychological status, tobacco use, alcohol consumption, taking oral contraceptives, increased parity, and gestational age and so on. In our study, although we have examined a wide range of possible risk factors, the findings only showed increased age and self-reported gum bleeding during tooth-brushing were associated with periodontal disease. This might be due to the high homogeneity of the study population. Most of the participants shared similar educational background, e.g. most of them with education no more than junior high school, most of their BMI being normal, the similar family income, gestational weeks, EPDS scores, and rare smoking behaviors.

Our findings are consistent with the prior reports that increased age was a risk factor of periodontal disease [26, 27]. Similar to another study [28], our study indicated that bleeding during tooth-brushing was significantly associated with periodontal disease. This finding suggested that, under the conditions lacking of routine oral health care, a sign of bleeding during tooth-brushing could be regarded as a risky indicator of periodontal disease, and the need of seeking for oral health care.

This study was one of very few ones to explore the factors associated with periodontal disease during pregnancy in rural areas of developing countries. The study showed PSR could be used as a simple, safe and rapid tool for detecting periodontal disease among pregnant women in rural areas.

As the study was the baseline survey of a RCT study, focusing on the periodontal disease and its association with pregnancy outcomes, women with several diseases such as moderate or severe dental caries, some systemic diseases, and sexual transmitted disease were excluded as a way of controlling for confounding factors. Therefore, the findings of this study may have the limitation of generalizability, and are more likely to be representative for healthy pregnant women. In addition, since the study was conducted in one hospital, the generalizability of the findings might be limited. Due to cross-sectional design, the causal effect cannot be identified between the risk factors and periodontal disease. Furthermore, factors included in the study might not be adequate, e.g. dietary information.

Conclusion

A high prevalence of periodontal disease was found among pregnant women in a rural area of China. Advanced maternal age and gum bleeding during tooth brushing were found to be associated with an increased risk of periodontal disease during pregnancy. The sign of gum bleeding during tooth-brushing might suggest the need of seeking for further oral health care.

Abbreviations

PSR: Periodontal Screening & Recording

RCT: Randomized Clinical Trial

EPDS: Edinburgh Postpartum Depression Scale

aOR: Adjusted Odds Ratios

95% *Ci*: 95% Confidence Interval

PRM: Premature Rupture of Membranes

GDM: Gestational Diabetes Mellitus

PIH: Pregnancy-induced Hypertension

Declarations

Ethics Approval and consent to participate

The research was approved by Fudan University School of Public Health Institutional Review Board that is registered with the Office for Human Research Protections (IRB# 2013-09-0462) and the Institutional Review Board of Tulane University, New Orleans, LA, USA (IRB#13–469160). Written informed consent was obtained from each participant before the study.

Consent for publication

Not Applicable.

Availability of data and material

The datasets generated and analyzed during the current study are not publicly available due the study was the baseline survey of a RCT study with confidential information but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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Authors' contributions

JH, XX and QX contributed to the design of the study and obtaining funding. JH and SY contributed to the design of the data collection instruments. JH (the monitor), CMQ, PJX, ZXL and WJH contributed to collecting data at the study site. CMQ and JH carried out data analyses and drafted the manuscript. JH and XX contributed to the modification of the manuscript. All authors have read and approved the manuscript.

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Tables

Table1 Characteristics of Women's Periodontal Health during Pregnancy in Leping

Characteristic		Non-PD (n=131)	Mild & Moderate PD (n=500)	Severe PD (n=17)
		N (%) or Median (P25, P75)	N (%) or Median (P25, P75)	N (%) or Median (P25, P75)
Age (years)		22 (20, 25)	24 (21,26)	23 (22,24)
Education	£Junior high	110 (84.0%)	414 (82.8%)	12 (70.6%)
	¤Senior high	21 (16.0%)	86 (17.2%)	5 (29.4%)
Income (yuan)	<3000	4 (3.1%)	10 (2.0%)	0 (0.0%)
	[3000, 6000]	109 (83.2%)	408 (81.6%)	13 (76.5%)
	>6000	18 (13.7%)	82 (16.4%)	4 (23.5%)
Employment	Unemployed	57 (43.5%)	172 (34.4%)	8 (47.1%)
	Employed	74 (56.5%)	328 (65.6%)	9 (52.9%)
Parity	0	42 (32.1%)	195 (39.0%)	3 (17.6%)
	¤1	89 (67.9%)	305 (61.0%)	14 (82.4%)
Gestation (week)		14.0 (11.0, 17.0)	15.0 (11.0,17.0)	14.0 (12.0,18.0)
EPDS score		10.0 (8.0, 13.0)	11.0 (8.0,14.0)	10.0 (8.0,13.0)
Oral health habits score		1.0 (0.0, 1.0)	1.0 (0.0, 1.0)	1.0 (0.0, 1.5)
BMI before pregnancy	£18.5	33 (25.2%)	116 (23.2%)	5 (29.4%)
	(18.5, 25)	92 (70.2%)	357 (71.4%)	12 (70.6%)
	¤25	6 (4.6%)	27 (5.4%)	0 (0.0%)
Self-reported smoking	No	129 (98.5%)	496 (99.2%)	17 (100.0%)
	Yes	2 (1.5%)	4 (0.8%)	0 (0.0%)
Periodontal family history	No	108 (82.4%)	438 (87.6%)	11 (64.7%)
	Yes	23 (17.6%)	62 (12.4%)	6 (35.3%)
Gum bleeding during tooth brushing	No	118 (90.1%)	359 (71.8%)	8 (41.7%)
	Yes	13 (9.9%)	141 (28.2%)	9 (52.9%)

Table2 Logistic Regression Analysis of Periodontal Disease during Pregnancy
i Univariate analysis
ii Multiple logistic regression, adjusted for all other variables in the table
a Mann-Whitney U test

Characteristics	PD vs. Non-PD (n=648)				Mild & moderate PD vs. Non-PD (n=631)					Severe PD vs. Non-PD (n=148)				
	p i	Adjusted OR	95% CI		p ii	p i	Adjusted OR	95% CI		p ii	p i	Adjusted OR	95% CI	
			Lower	Upper				Lower	Upper				Lower	Upper
Age (year)	<0.001* ^a	1.129	1.057	1.205	<0.001*	<0.001* ^a	1.129	1.058	1.206	<0.001*	0.329 ^a	1.084	0.848	1.386
Education	0.671 ^b	0.753	0.411	1.381	0.359	0.751 ^b	0.710	0.401	1.351	0.322	0.178 ^b	1.334	0.257	6.933
Income	0.551 ^b	1.122	0.668	1.885	0.664	0.609 ^c	1.093	0.649	1.840	0.739	0.386 ^c	3.439	0.713	16.590
Employment	0.065 ^b	1.478	0.968	2.256	0.070	0.054 ^b	1.541	1.008	2.356	0.046*	0.782 ^b	0.261	0.058	1.163
Parity	0.187 ^b	1.116	0.682	1.827	0.661	0.144 ^b	1.087	0.664	1.781	0.739	0.274 ^c	4.495	0.611	33.081
Gestation (week)	0.538 ^a	1.005	0.955	1.058	0.851	0.582 ^a	1.004	0.953	1.057	0.887	0.350 ^a	0.991	0.838	1.172
BMI before pregnancy	0.885 ^b	0.988	0.660	1.480	0.955	0.849 ^b	1.004	0.663	1.490	0.977	0.643 ^b	0.550	0.159	1.896
Self-reported smoking	0.350 ^c	0.497	0.079	3.147	0.458	0.609 ^c	0.514	0.081	3.265	0.481	1.000 ^c	--	--	--
EPDS score	0.402 ^a	1.024	0.976	1.075	0.338	0.396 ^a	1.024	0.975	1.075	0.340	0.863 ^a	0.906	1.234	1.058
Periodontal family history	0.195 ^b	0.655	0.377	1.138	0.133	0.124 ^b	0.626	0.358	1.096	0.101	0.083 ^b	3.723	0.953	14.540
Oral health habits score	0.400 ^a	1.078	0.826	1.408	0.580	0.405 ^a	1.079	0.824	1.412	0.591	0.708 ^a	0.807	0.509	2.380
Gum bleeding during tooth brushing	<0.001* ^b	3.762	2.048	6.995	<0.001*	<0.001* ^b	3.647	1.968	6.760	<0.001*	<0.001* ^b	15.867	4.037	62.353 <

^b Pearson product moment correlation χ^2 test

^c Fisher's exact test

Table3 Linear trend of severity of periodontal disease (none, mild/moderate, severe) with risk factors in multivariable linear regression

Risk factors	Slope (95% CI)	P	Risk factors	Slope (95% CI)	P
Age (year)	0.148 (0.006, 0.025)	0.001*	BMI before pregnancy	-0.014 (-0.080, 0.055)	0.710
Education	-0.015 (-0.116, 0.081)	0.731	Self-reported smoking	-0.032 (-0.500, 0.203)	0.407
Income	0.032 (-0.049, 0.119)	0.416	EPDS score	0.033 (-0.005, 0.011)	0.395
Employment	0.040 (-0.036, 0.109)	0.319	Periodontal family history	-0.014 (-0.115, 0.081)	0.728
Parity	0.027 (-0.056, 0.106)	0.541	Oral health habits score	0.030 (-0.027, 0.058)	0.464
Gestation (week)	0.015 (-0.007, 0.010)	0.696	Gum bleeding during tooth brushing	0.201 (0.127, 0.283)	<0.001*