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CLINICAL ARTICLE

Risk factors for preterm premature rupture of membranes in Chinese women from urban cities

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ABSTRACT

Objective: To investigate the prevalence of preterm premature rupture of membranes (PPROM) in urban areas in China and examine the associated risk factors. *Methods:* A population-based, prospective study was undertaken in 14 cities in China between January 1, 2011, and January 31, 2012. Women were recruited at their first prenatal-care visit, when maternal characteristics were recorded. Risk factors were analyzed by one-way analysis of variance. *Results:* Of 112 439 women included in analyses, 3077 (2.7%) had PPROM. Univariate analysis showed an increased risk of PPROM before 28 weeks of pregnancy in migrant women (odds ratio [OR] 2.25; 95% confidence interval [CI] 1.53–3.30; $P < 0.001$), in those with a history of recurrent induced abortions (OR 2.75; 95% CI 1.66–4.56; $P < 0.001$), and in those with a history of preterm birth (OR 3.90; 95% CI 0.77–19.61; $P < 0.001$). The associations were maintained in multivariate analysis ($P < 0.001$). *Conclusion:* Migration as a result of urbanization, high rates of induced abortion, and preterm birth are potential risk factors for PPROM in Chinese women.

1. Introduction

Preterm premature rupture of membranes (PPROM) occurs spontaneously before 37 weeks of pregnancy. It complicates approximately 3% of pregnancies [1] and accounts for 20%–30% of all preterm births [2]. PPROM is associated with cerebral palsy and behavioral and educational difficulties in children, the risks of which increase as length of gestation at birth decreases [3–5]. Midtrimester PPROM occurring before 28 weeks reduces neonatal viability and survival [6–8]. There is a significant risk of perinatal morbidities and mortality even after expectant management with tocolytic drugs, antenatal corticosteroids, and prophylactic antibiotics [9–13]. Therefore, the prevention of PPROM in women at high risk and reduction of associated disability are important health priorities. Identification of maternal risk factors before conception or early in pregnancy could lead to the discovery of new and effective interventions that could help to prevent PPROM.

Previous studies have shown that the risk factors for spontaneous preterm birth include black maternal ethnic origin, previous adverse pregnancy outcome, genitourinary infections, smoking, extremes of body weight and social disadvantage, maternal depression, prepregnancy stress, poor diet, assisted fertility, and periodontal disease [14]. A focus on low-income settings might be key to reduce preterm birth worldwide [15].

In China, poverty is still a large issue, and in view of the large population, adverse birth events and prematurity could lead to large numbers of disabled individuals placing a potential burden on worldwide healthcare resources. However, the epidemiology of PPROM in Chinese women is poorly understood. Moreover, China is undergoing a dramatic demographic shift from a mostly rural population to an urban population [16], which could affect the incidence of PPROM. Therefore, the epidemiology of PPROM and its risk factors need to be analyzed to guide further prevention and provide data for preterm birth in low-income countries. The aim of the present study was to investigate the prevalence of PPROM in urban areas in China and to examine the pattern of demographic and obstetric characteristics of affected women.

2. Materials and methods

Between January 1, 2011, and January 31, 2012, a population-based prospective study was undertaken by the Chinese Obstetric Pregnancy and Delivery Collaborated Group in Beijing, Shanghai, Xi'an, Nanjing, Jinan, Chengdu, Shenyang, Wuhan, Guangzhou, Changchun, Urumqi,

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Hohhot, Taiyuan, and Cangzhou. Women were recruited at their first prenatal-care visit and enrolled on delivery. Women who were younger than 14 years or older than 60 years were excluded. Women with preterm birth without PPROM and multifetal pregnancies were excluded from the analysis. The study was approved by the research ethics committee of the Obstetrics and Gynecology Hospital affiliated with Fudan University. Informed consent was obtained.

Premature rupture of membranes (PROM) was defined as rupture of the membrane of the amniotic sac and chorion more than 1 hour before the onset of labor. PPROM was defined as PROM before 37 weeks of pregnancy [17]. PROM and PPROM were diagnosed by pH evaluation or measurement of insulin-like growth factor binding protein-1. Management during this period was standardized with respect to the birth outcomes. We divided the participants into five groups: full-term pregnancy without PROM, PROM at 37 weeks of pregnancy or later, PPROM at 34–36 weeks of pregnancy, PPROM at 28–33 weeks of pregnancy, and PPROM at fewer than 28 weeks of pregnancy.

Gestational age of the fetus was established by date of last menstrual period and had been confirmed by first-trimester ultrasonography. On the first prenatal visit, maternal age, weight, height, paternal age, residence status, smoking, alcohol consumption, delivery history, medical history, family history, and adverse pregnancy outcome history had been established. An abnormal medical history included hypertension, diabetes, cardiac diseases, diseases of the immune system, renal diseases, and other chronic diseases. Past adverse pregnancy history mainly included induced abortion, spontaneous abortion, fetal birth, stillbirth, neonatal death, fetal abnormality, preterm birth, and history of multiple pregnancies. The occurrence of specific conditions (e.g. hypertension, diabetes, congenital diseases) in first-degree relatives was recorded. We defined induced abortion as a fetus or embryo removed or expelled from the uterus before 20 weeks, or in the absence of accurate dating criteria, born weighing less than 500 g [18]. Women were deemed to have had recurrent abortion if it had happened at least three times [19]. Women were deemed to be migrants when they did not have a registered residence at their first prenatal visit.

Statistical analysis was performed in SPSS version 15.0 (SPSS Inc, Chicago, IL, USA). We compared the demographic and obstetric characteristics of women in the five groups using *t* tests or one-way analysis of variance with Bonferroni correction for comparison of continuous variables, and χ^2 tests for comparison of categorical variables. *P* values were two-tailed, and $P < 0.05$ was considered to be statistically significant.

We tested prediction values of demographic and obstetric parameters by univariate and multinomial logistic regression. Group was the dependent variable, demographic and obstetric parameters were factors and main effects model type. Odds ratios (ORs), 95% confidence intervals (CIs), and the significance level of the Wald statistic were used to quantify the effect of each predictor.

We also generated predictive models for PROM by different gestational ages based on the predictor values in logistic regression by multilayer perceptron (MLP) of neural networks. We chose custom architecture for model set; PPROM at 34–36 weeks, 28–33 weeks, and at fewer than 28 weeks were selected as dependent variables; and migrant status, history of recurrent induced abortions, and history of preterm birth as factors. To improve the learning performance of the system, each set was randomly applied. The data were divided into two subsets, and one subset was used for training and the other for testing. The relative number of cases to assign to the testing sample was 70%, while 30% were assigned to the holdout sample. The independent variable importance analysis was used for further analysis.

3. Results

A total of 117 330 Chinese women who attended routine prenatal care in the 14 cities were recruited, of whom 112 439 were included in analysis (Figure 1, Table 1). A total of 3077 (2.7%) women had PPROM. The lowest frequency of PPROM was recorded in Wuhan, where 18 (0.3%) of 6022 women were affected, and the highest in Shenyang, where 605 (6.1%) of 9885 women were affected.

Women with PPROM were more likely to be migrants, have a history of preterm birth, have had at least two induced or spontaneous abortions, have a lower body mass index (calculated as weight in kilograms divided by the square of height in meters) at delivery, and have a lower weight gain during pregnancy (Table 2). The earlier gestational age at which PPROM occurred coincided with an increasing proportion of risk factors. Additionally, women who experienced PPROM at 28–36 weeks of pregnancy tended to be older and have a history of

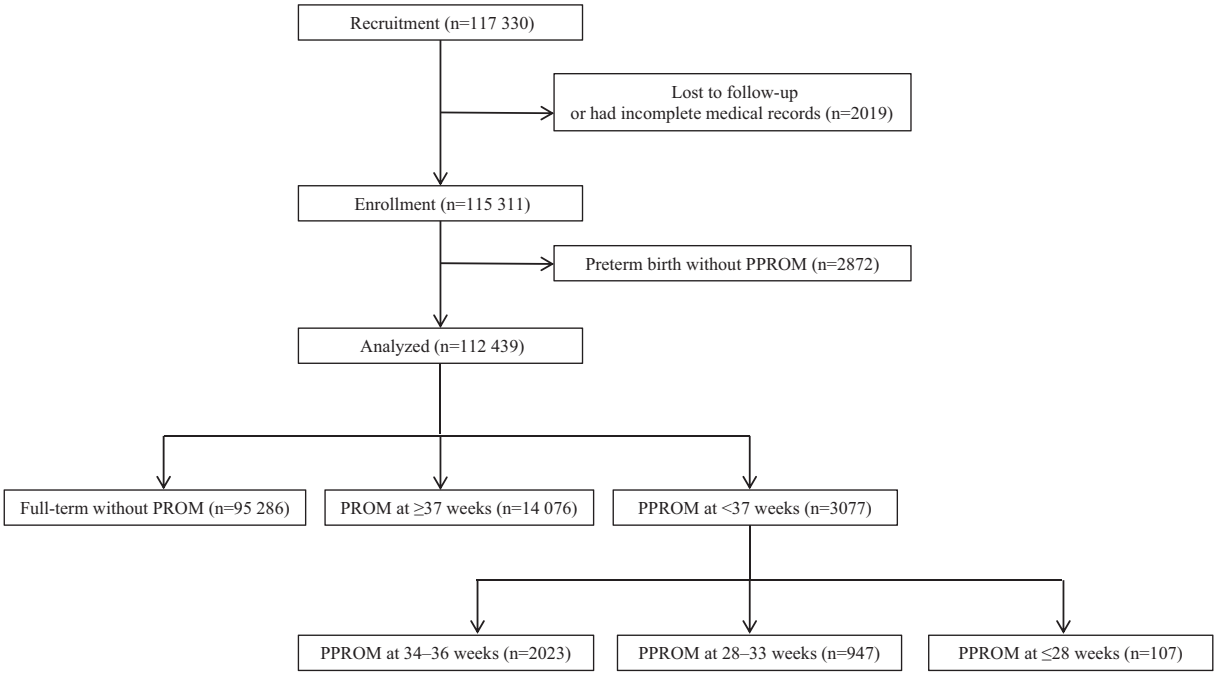

Fig. 1. Flow of participants through the study. Abbreviations: PPROM, preterm premature rupture of membranes; PROM, premature rupture of membranes.

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