



## Attendance at prenatal care and adverse birth outcomes in China: A follow-up study based on Maternal and Newborn's Health Monitoring System

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### ABSTRACT

**Objective:** to evaluate the independent association between attendance at prenatal care and adverse birth outcomes in China, measured either as the occurrence of preterm birth or low birth weight.

**Design:** a follow-up study.

**Setting:** the data was collected from maternal and newborn's health monitoring system at 6 provinces in China.

**Participants:** all pregnant women registered in the system at their first prenatal care visit. We included 40152 registered pregnant women who had delivered between October 2013 and September 2014.

**Measurements:** attendance at prenatal care was evaluated using Kessner index.  $\chi^2$  tests were used to examine the correlations between demographic characteristics and preterm birth or low birth weight. The associations between attendance at prenatal care and birth outcomes were explored using multilevel mixed-effects logistic regression models.

**Findings:** the prevalence for preterm birth and low birth weight was 3.31% and 2.55%. The null models showed region clustering on birth outcomes. Compared with women who received adequate prenatal care, those with intermediate prenatal care (adjusted OR 1.62, 95%CI 1.37–1.92) or inadequate prenatal care (adjusted OR 2.78, 95%CI 2.24–3.44) had significantly increased risks for preterm birth, and women with intermediate prenatal care (adjusted OR 1.31, 95%CI 1.10–1.55) or inadequate prenatal care (adjusted OR 1.70, 95%CI 1.32–2.19) had significantly increased risks for low birth weight. We found very significant dose-response patterns for both preterm birth (p-trend < 0.001) and low birth weight (p-trend = 0.001).

**Key conclusions and implication for practice:** This study shows that attendance at prenatal care in China has independent effects on both preterm birth and low birth weight. Appropriate timing and number of prenatal care visits can help to reduce the occurrence of preterm birth or low birth weight.

### Introduction

Preterm birth and low birth weight have well-known effects on infant morbidity and mortality (Krans and Davis, 2012). Preterm birth is the world's leading cause of death in children under 5 years old. More than 60% of all preterm births occurs in Sub-Saharan Africa and South Asia. The highest rate is found in Southeastern and South Asia where 13.4% of the children are born preterm (Koullali et al., 2016). Low birth weight infants are 3 times more likely to have neurodevelopmental deficits. They also have a significantly increased risk of having a prolonged illness, which is linked to two-thirds of all infant deaths (McCormick, 1985). Compared to other Western countries, China has a

very low rate of preterm birth and low birth weight. But there is a lack of nationwide data about preterm birth, and the rate of preterm birth was about 5% according to some studies in China. The rate of low birth weight in China was 2.38% in 2012. No significant changes have been observed since 2000 (National Health and Family Planning Commission of China, 2013).

In the past few decades, considerable studies on the determinants of preterm birth and low birth weight have been performed, and some interventions have been adopted to reduce the incidence of preterm birth and low birth weight. However, the coverage rates of these interventions in low and middle-income countries remain very low. Prenatal care is identified as one of the efficacious interventions to

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prevent adverse birth outcomes in recent years.

Prenatal care was developed in Europe at the beginning of the 20th century and then gradually introduced into developing countries. It was in the 1970s when prenatal care was introduced into China (Wu et al., 2008). The results of China Health Statistical Yearbook in 2013 showed that the proportion of prenatal care coverage had been increased to 95.0% till 2012, and the proportion of pregnant women with the first prenatal care visit before 13 weeks of gestation was 65.2% in 2008. There are indices to measure the adequacy of prenatal care, such as Kessner index (Barros et al., 1996; Bloch et al., 2009), APNCU index (Kotelchuck, 1994), GINDEX index (Tayebi et al., 2014), especially when assessing the relationship between prenatal care and birth outcomes. Kessner index is the first and still most widely recognised index to measure the adequacy of prenatal care (Bloch et al., 2009).

A study about prenatal care used Kessner index and APNCU index in a preterm birth population to assess the adequacy of prenatal care (Bloch et al., 2009). Some studies demonstrated that adequate prenatal care is effective in improving preterm birth (Debiec et al., 2010; Beeckman et al., 2013). Some studies described the association between attendance at prenatal care and low birth weight using prenatal care visits. Tayebi et al.'s research showed that the probability of premature labor in inadequate care group was 3.93 times higher than that of the adequate and intensive care group, and the probability of low birth weight was 2.53 times higher (Tayebi et al., 2014). Studies were done mainly in developed countries like American and Britain in the 20th century and the beginning of the 21st century (Rowe and Garcia, 2003). Recently some developing countries are making efforts on these studies, such as Kenya (Awiti, 2014; Brown et al., 2008). However, there is little evidence of the relationship between prenatal care indices and birth outcomes in China.

According to the previous studies, inadequate prenatal care was a risk factor for adverse birth outcomes, and there is a lack of studies about prenatal care indices and adverse birth outcomes in some developing countries. This study aims to evaluate the role of attendance at prenatal care for preterm birth and low birth weight in the Chinese population.

## Methods

### Study site and population

Data for this study was obtained from Maternal and Newborn's Health Monitoring System in China. The system was established to comprehensively monitor the prenatal health care and pregnancy outcomes information of pregnant women from 12 districts/counties of 6 provinces in 2012. The 6 provinces, including Hebei, Liaoning, Hunan, Fujian, Sichuan, Yunnan, then one city from each province and two districts/counties from each city were selected randomly by a three-stage cluster sampling. All pregnant women who were residents or lived more than 6 months at these places were enrolled at their first prenatal visit, and then their information before, during, and shortly after pregnancy would be collected in the system. The system contained information of large numbers of pregnancy women, providing an opportunity to explore the association between attendance at prenatal care and birth outcomes in a population-based sample.

### Data collection procedures

All pregnant women registered in the system at their first prenatal care visit and recorded data on the districts, type of residence, maternal race/ethnicity, maternal age, maternal education, and parity. Additionally, each pregnant woman received a complete physical examination including weight measurement, obstetric examination, hemoglobin examining, hepatic and renal function examination and

ultrasound examination. Current pregnancy information including gestational age, mode of delivery, child's sex, birth weight, Apgar score (1 min, 5 min), and other pregnancy outcomes was collected. Prior to data collection, our study was approved by the Ethics Committee for Human Subjects Studies. The study was exempt from informed consent because that all the information in our study was collected from Maternal and Child Care Handbook written by doctors in place of collecting data face-to-face with the objects, and the data we used was lack of identification of individuals.

### Data cleaning

All pregnant women in our study were delivered between October 2013 and September 2014 ( $n = 40679$ , 100%). We excluded women with multiple pregnancies ( $n = 346$ , 0.85%) to homogenise and simplify the calculations of the attendance at prenatal care, as well as stillbirths ( $n = 70$ , 0.17%). We further excluded women whose birth weight information was missing ( $n = 111$ , 0.27%). The final study population was reduced to 40152 (98.70%) pregnant women with uncomplicated pregnancies.

### Measures

The attendance at prenatal care was estimated based on the Kessner Index (Alexander and Kotelchuck, 1996). The index combines three variables: the start of prenatal care, the total number of consultations, and the length of pregnancy. The Kessner index defines attendance at prenatal care to three levels, inadequate, intermediate and adequate. A woman is classified to the adequate prenatal care category if her care started in the first trimester and the number of visits she received was at least nine. Relatively, a woman is classified to the inadequate category if she received no care at all, if her care started in the third trimester, or if the number of visits she received was fewer than four. Women with any other combinations of values of the relevant variables are assigned to the intermediate category.

The main birth outcomes variables were preterm birth and low birth weight. Preterm birth was defined by a WHO expert committee in 1969 as delivery occurring before 37 completed weeks of gestation (World Health Organization, 1970). Gestational age was calculated by subtracting the last menstrual period from the date of delivery, which can be obtained from medical record of pregnancy women. Low birth weight was defined as the weight of infants at the birth of fewer than 2500 g (World Health Organization, 2014), and it can get from the database directly.

We considered province Hebei and Liaoning as the region of northeast, and the province Hunan and Fujian as the region of midland, and the province Sichuan and Yunnan as the region of southwest. We included maternal age as a categorical variable, and the maternal age was divided into three groups. We calculated the BMI of pre-pregnancy according to the definition of BMI from WHO in 2000 (World Health Organization, 2000).

### Statistical analysis

Analysis of data was performed with the Stata software (Stata/SE, version 12.1). A cutoff P value of  $< 0.05$  was considered of statistical significance, and all p-values were bilateral. Descriptive statistics of all study variables were calculated proportions and chi-square for categorical variables. Multilevel mixed-effects logistic regression models were used to identify the associations of preterm birth and low birth weight with Kessner index. Odds ratios with 95% confidence intervals estimated by this basic model were treated as crude odds ratios. To estimate the adjusted odds ratios with 95% confidence intervals, regression model was performed adjusting for confounding factors.

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