Preplanned Studies

Prevalence and Risk Factors of Anemia of Pregnant Women — 6 Provinces in China, 2014–2018

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Summary
What is already known about this topic?
Anemia during pregnancy is a global public health problem affecting both maternal and children’s health. The “National Nutrition Plan (2017–2030)” and “Healthy China Action (2019–2030)” issued by the State Council of China in 2017 and 2019, respectively, specified nutrition targets: by 2030, the anemia rate in pregnant women should be reduced to less than 10%.

What is added by this report?
Past surveillance in 2010–2012 did not divide pregnant women by gestation week, and the sample size was only 4,315 cases. In this study, the information of 206,753 registered pregnant women from their first antenatal care (ANC) examination to childbirth was collected from 2014 to 2018. The overall prevalence of anemia among pregnant women was 41.98%.

What are the implications for public health practice?
The overall prevalence of anemia among pregnant women in the monitoring areas was high, far from the target of 10%. Anemia remains a serious health problem among pregnant women in China. It is urgent to develop effective strategies and take measures to reduce the prevalence of anemia in China.

Anemia affects roughly one third of the world’s population (I). Approximately 40.1% of pregnant women worldwide were estimated to be anemic in 2016 (2). Evidence shows that maternal anemia is associated with poor birth outcomes, including low birth weight, prematurity, maternal and perinatal mortality, and also poor cognitive and motor development outcomes in children (2–3).

Furthermore, anemia remains a persistent problem among women in China. An estimated 26.4% of women of reproductive age (15–49 years) were anemic in 2016, which translates to 95.0 million women affected, an increase of 16.9 million in absolute numbers from 2012 (20.7% among women of reproductive age) (I).

In 2011, the “Development Outline for Chinese Women (2011–2020)” (4) released by the State Council of China put forward a target of reducing the prevalence of moderate and severe anemia during pregnancy by 2020. The “National Nutrition Plan (2017–2030)” (5) and “Healthy China Action (2019–2030)” (6) issued by the State Council of China in 2017 and 2019, respectively, specified nutrition targets: by 2030, the anemia rate in pregnant women should be reduced to less than 10%. Therefore, this study aims to understand the current levels of anemia during pregnancy in China and to determine how far they are from the 2030 target.

The data of this study were obtained from the Maternal and Newborn Health Monitoring System* (MNHMS) set up by the National Center for Women and Children’s Health (NCWCH) for Maternal and Newborn Health Monitoring Program† (MNHMP) in 2013. All pregnant women who were residents or who had lived more than six months in these places were enrolled at their first antenatal care (ANC) examination, the information about their ANC during pregnancy was collected from the Maternal and Child Care Handbooks, and the information of delivery was collected from their delivery registrations. Finally, all the data was recorded in the MNHMS.

* The MNHMS was established to monitor the prenatal health care and pregnancy outcomes of pregnant women from 16 districts/counties of 8 provinces. Because 2 of the provinces have been included in the program since 2015, to maintain the continuity and integrity of the data, the study only selected data from the other 6 provinces for analysis. The 6 provinces (with the selected districts) are: Hebei (Xinhua and Zhengding), Liaoning (Lishan, Tiedong, and Taian), Hunan (Yueyanglou and Yueyang), Fujian (Haicang and Jimei), Sichuan (Gongjing and Rong County), and Yunnan (Tonghai and Huaning). Taian stopped surveillance in 2016, and Tiedong County became the participant since then.
† To ensure the quality of the information, the system set many logic checks to prevent wrong inputs. In addition, the staff of the NCWCH conducted field supervision on data accuracy every year. MNHMP was approved by the Ethics Committee of NCWCH (No.FY2015-007).
In the MNHMS, a total of 210,526 women (delivered live births between January 1, 2014 and December 31, 2018) had received at least 1 hemoglobin (Hb) test during prenatal care. Women whose last menstrual period (LMP) was missing (150 persons) and with multiple pregnancies (3,623 persons) were excluded. Finally, the data of 206,753 registered pregnant women were analyzed in this study.

According to World Health Organization (WHO) criteria (7), anemia in pregnancy was defined as Hb < 110 g/L at any antenatal examination of any gestation week. Mild, moderate, and severe anemia are defined as Hb measurements between 100 and 109 g/L, 70–99 g/L, and less than 70 g/L, respectively. Since the altitude of the two counties of Yunnan Province was 1,900 meters, a revised diagnostic criteria for anemia of Hb < 117 g/L was used. For the two counties, mild, moderate, and severe anemia was defined as Hb measurements between 108 and 117 g/L, 78–107 g/L, and less than 78 g/L, respectively.

Prevalence rates were estimated overall and by subgroups. T-tests and Rao-Scott chi-square tests were conducted to explore the differences between groups in variables and prevalence. Multivariable logistic regression models were used to explore the factors associated with prevalence of anemia among the pregnant. All statistical analyses were conducted by SAS software (version 9.4, SAS Institute Inc, Cary, USA).

The number of participants in the anemic and non-anemic groups was 86,802 and 119,951, respectively. The overall prevalence of anemia among pregnant women was 41.98% (86,802/206,753). Table 1 shows the maternal characteristics of the anemic group versus the non-anemic group. Gestation week of the first ANC, maternal age, gravidity, parity, number of ANC examinations, number of Hb tests, and delivery week between the anemic group and the non-anemic group were statistically significant (Table 1).

There was no significant differences in the prevalence of anemia in different years. For each year between 2014 to 2018, the prevalence was 41.24%, 43.51%, 43.67%, 43.82%, and 36.76%, respectively. For details, the prevalence of anemia of different levels among pregnant women from each year between 2014 to 2018 are shown in Supplementary Figure S1 (available in http://weekly.chinacdc.cn).

A total of 206,753 women were assessed to evaluate the associated risk factors. The prevalence of anemia among pregnant women based on location, maternal age, educational status, parity, number of prenatal examinations, number of Hb tests, and week of delivery were statistically significant (Table 2).

The results of multivariate logistic regression analysis showed that age under 25 years; residing in China’s northwest region, southwest region, or urban areas; having delivered before; and being in the second or third trimester were the predictors of anemia in pregnancy. Anemic pregnant women may have received more than five ANC examinations or more than three Hb tests during gestation. The details are shown in Table 3.

**DISCUSSION**

Anemia during pregnancy is a global public health problem affecting both maternal and children’s health in developing and developed countries. In this study, 6 provinces in China, 2014–2018.

| Variables                      | Non-anemia (N=119,951) | Anemia (N=86,802) | Total (N=206,753) | t     | p    |
|--------------------------------|------------------------|-------------------|-------------------|-------|------|
| Hb (g/L)                       | 126.72±10.08           | 103.32±7.23       | 116.90±14.63      |       |      |
| Gestation week of the first ANC| 14.05±6.85             | 14.56±6.55        | 14.26±6.73        | -16.80| <0.001|
| Maternal age                   | 28.03±4.61             | 27.85±4.68        | 27.95±4.64        | 8.88  | <0.001|
| Gravidity                      | 2.00±1.10              | 2.06±1.10         | 2.03±1.10         | -12.77| <0.001|
| Parity                         | 0.51±0.57              | 0.55±0.58         | 0.53±0.57         | -17.91| <0.001|
| Number of ANC examinations     | 7.62±3.40              | 8.41±2.99         | 7.95±3.26         | -54.45| <0.001|
| Number of Hb tests             | 3.57±1.85              | 4.37±1.91         | 3.91±1.91         | -95.76| <0.001|
| Week of delivery               | 39.07±2.05             | 39.12±2.35        | 39.09±2.78        | -4.22 | <0.001|

Note: The six provinces (with the selected districts) are: Hebei (Xinhua and Zhending), Liaoning (Lishan, Tiedong and Taian), Hunan (Yueyang and Yueyang), Fujian (Haicang and Jimei), Sichuan (Gongjing and Rong County) and Yunnan (Tonghai and Huangai). Taian stopped surveillance in 2016, so Tiedong County became the participant since then. Abbreviation: ANC=antenatal care, Hb=hemoglobin.
the overall anemia prevalence among pregnant women was 41.98%, which is consistent with the global estimates of anemia prevalence during pregnancy (40.1%) in 2016 (2), but significantly higher than the anemia prevalence during pregnancy (17.2%) reported by the Chinese Nutrition and Health Surveillance in 2010–2012 (7). Further analysis of data from the Chinese Nutrition and Health Surveillance found that the surveillance was conducted from 2010 to 2012 and that the sample size was only 4,135 pregnant women. Moreover, the gestational age of pregnant women and the altitude of the monitoring areas were not taken into account (8).

From 2014 to 2018, the overall prevalence and the prevalence of moderate and severe anemia remained unchanged, indicating that no effective intervention has taken place in these areas. If current trends continue, the 2020 target of reducing the prevalence of

| TABLE 2. Prevalence of anemia among pregnant women in different trimesters — 6 provinces in China, 2014–2018. |
|---------------------------------------------------------------|
| **Variables** | **First trimester (<13 weeks)** | **Second trimester (<28 weeks)** | **Third trimester (≥36 weeks)** | **Total** |
| **Number** | **Prevalence of anemia (%)** | **χ²** | **Number** | **Prevalence of anemia (%)** | **χ²** | **Number** | **Prevalence of anemia (%)** | **χ²** |
| **Regions** | | | | | | | | | |
| Northeast | 14,581 | 4.62 | 36,875 | 43.05 | 24,881 | 80.85 | 76,337 | 48.03 | 2614.20 |
| Central | 37,018 | 8.56 | 22,646 | 43.12 | 24,372 | 69.60 | 84,036 | 35.58 | 143.29 |
| Southwest | 17,478 | 8.29 | 12,918 | 48.53 | 15,984 | 78.33 | 46,380 | 43.64 | 69.158 |
| **Age** | | | | | | | | | |
| <25 | 15,740 | 8.41 | 14,679 | 46.11 | 15,258 | 78.39 | 45,688 | 43.90 | 89.04 |
| 25–35 | 47,196 | 7.24 | 50,312 | 43.51 | 43,745 | 76.16 | 140,983 | 41.44 | 122.32 |
| >35 | 5,875 | 8.75 | 7,155 | 43.48 | 6,207 | 69.79 | 19,252 | 41.38 | 354.32 |
| **Education** | | | | | | | | | |
| Junior high or lower | 25,983 | 8.94 | 25,151 | 46.33 | 26,946 | 77.72 | 78,080 | 44.72 | 182.86 |
| Senior high school | 18,333 | 7.94 | 16,565 | 45.10 | 16,417 | 75.86 | 51,315 | 41.66 | 232.70 |
| University or above | 23,139 | 6.08 | 30,098 | 41.83 | 21,252 | 74.41 | 74,489 | 40.02 | 232.70 |
| **Parity** | | | | | | | | | |
| 0 | 34,580 | 6.93 | 36,893 | 43.88 | 30,128 | 76.24 | 101,601 | 40.90 | 306.23 |
| ≥1 | 28,712 | 8.40 | 34,345 | 44.45 | 34,264 | 75.61 | 97,321 | 44.78 | 182.86 |
| **Number of ANC examinations** | | | | | | | | | |
| <5 | 4,311 | 4.87 | 9,252 | 23.02 | 6,099 | 50.93 | 19,662 | 27.70 | 232.70 |
| ≥5 | 64,766 | 7.85 | 63,187 | 47.13 | 59,138 | 78.62 | 187,091 | 43.48 | 182.86 |
| **Number of Hb tests** | | | | | | | | | |
| <3 | 13,552 | 5.77 | 20,676 | 23.97 | 15,388 | 50.79 | 49,612 | 27.32 | 232.70 |
| ≥3 | 55,252 | 8.12 | 51,763 | 52.07 | 49,849 | 83.83 | 157,137 | 46.61 | 5764.56 |
| **Delivery week** | | | | | | | | | |
| <37 weeks | 2,822 | 6.45 | 69,158 | 44.27 | 63,342 | 76.34 | 198,755 | 42.30 | 215.88 |
| ≥37 weeks | 66,255 | 7.71 | 3,281 | 39.47 | 1,895 | 65.70 | 7,998 | 34.03 | 215.88 |

Note: The six provinces (with the selected districts) are: Hebei (Xinhua and Zhengding), Liaoning (Lishan, Tiedong, and Taian), Hunan (Yueyanglou and Yueyang), Fujian (Haicang and Jimei), Sichuan (Gongjing and Rong County) and Yunnan (Tonghai and Huaning). Rao-Scott chi-square tests were conducted to test for differences in prevalence for unordered categorical variables. Based on the economic development level and administrative divisions, Hebei and Liaoning provinces represented the northeast region, Hunan and Fujian provinces the central region, and Sichuan and Yunnan provinces the southwest region. In addition, pregnant woman were classified as natives or outsiders of the counties on the basis of the census registration. Gestational week was based on the number of days between the first day of an expectant mother’s LMP and the date of antenatal examination. The first, second, and third trimester were defined as a gestational age less than 13 weeks, 13–27 weeks, and 28–42 weeks, respectively.

*p<0.001.
†p<0.05.
moderate and severe pregnancy anemia (4) will not be met. In 2018, anemia affected 41.98% of pregnant women in the monitoring areas — more than triple and quadruple the Healthy China Action (2019–2030) (6) targets of less than 14% by 2022 and less than 10% by 2030, making it extremely challenging to achieve the targets.

The results of this study show wide variations in prevalence across regions — from 35.58% in China’s central region, 43.64% in the southwestern region, and 48.03% in the northeastern region. These results are supported by another multi-center study: the anemia prevalence in Guangzhou (eastern region) (38.8%) and Chengdu (western region) (23.9%) was significantly higher than in Beijing (central region) (19.3%) (9). These variations across regions might be attributed to the different socioeconomic conditions, lifestyle, diet, or health-seeking behaviors across different cultures (10).

Although the prevalence of anemia was high in this study, the prevalence of mild anemia was highest (40.82%) and the proportion of mild anemia was almost 90%. This statistic suggests that as long as the health agencies pay attention to the prevention and

| Variables                              | OR      | 95% CI  | p value |
|----------------------------------------|---------|---------|---------|
| Region                                 |         |         |         |
| Central                                | Ref     |         |         |
| Northeast                              | 1.242   | 1.208–1.278 | <0.001 |
| Southwest                              | 1.191   | 1.151–1.222 | <0.001 |
| Age (years)                            |         |         |         |
| <25                                    | 1.186   | 1.151–1.222 | <0.001 |
| 25–35                                  | Ref     |         | <0.001 |
| ≥35                                    | 0.93    | 0.894–0.967 | <0.001 |
| Education                              |         |         |         |
| Junior high or lower                   | Ref     |         |         |
| Senior high                            | 0.897   | 0.871–0.924 | <0.001 |
| University or above                    | 0.842   | 0.818–0.867 | <0.001 |
| Parity                                 |         |         |         |
| 0                                      | Ref     |         |         |
| ≥1                                     | 1.132   | 1.103–1.161 | <0.001 |
| Number of ANC examinations             |         |         |         |
| <5                                     | Ref     |         |         |
| ≥5                                     | 1.632   | 1.564–1.702 | <0.001 |
| Number of Hb tests                     |         |         |         |
| <3                                     | Ref     |         |         |
| ≥3                                     | 3.289   | 3.192–3.388 | <0.001 |
| Trimester                              |         |         |         |
| First (<13 weeks)                      | Ref     |         |         |
| Second (<28 weeks)                     | 11.248  | 10.863–11.646 | <0.001 |
| Third (≥36 weeks)                      | 47.220  | 45.530–48.973 | <0.001 |

Note: The six provinces (with the selected districts) are: Hebei (Xinhua and Zhengding), Liaoning (Lishan, Tiedong and Taian), Hunan (Yueyangliou and Yueyang), Fujian (Haicang and Jimei), Sichuan (Gongjing and Rong County) and Yunnan (Tonghai and Huaning). Taian stopped surveillance in 2016, so Tiedong County became the participant since then. Based on the economic development level and administrative divisions, Hebei and Liaoning provinces represented the northeast region, Hunan and Fujian provinces the central region, and Sichuan and Yunnan provinces the southwest region. In addition, pregnant woman were classified as natives or outsiders of the counties based on their census registration. Gestational week was based on the number of days between the first day of an expectant mother’s LMP and the date of antenatal examination. The first, second, and third trimester were defined as a gestational age less than 13 weeks, 13–27 weeks, and 28–42 weeks, respectively.

Abreviation: ANC=antenatal care. OR=odds ratio. CI=Confidence interval.
control of anemia and deal with mild anemia effectively as soon as it is found, the prevalence rate of anemia could be effectively controlled.

One of the strengths of this study is the use of anemia data from individual clinical data of pregnant women in all midwifery institutions in the monitoring areas. Thus, the study findings are more accurate, more convincing, and more instructive for policy decision-making than aggregated data. However, the study used convenience sampling, and the monitoring area was limited to 12 counties/districts in 6 provinces, so the results might not be representative of the regional and national levels.

Nevertheless, the results of this study provide a basis for policy makers to understand the current situation of anemia among pregnant women and to formulate targeted intervention measures as soon as possible.

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SUPPLEMENTARY FIGURE S1. Prevalence of anemia of different levels among pregnant women — 6 provinces in China, 2014–2018.