Preplanned Stduies

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

Huanqing Hu[1]; Aiqun Huang[1]; Qi Yang[1]; Wei Zhao[1]; Yu Ma[1]; Jiangli Di[1,#]

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%. The anemia prevalence of pregnant women reported by the Chinese Nutrition and Health Surveillance in 2006 and 2010–2012 was 42.0% and 17.2%, respectively.

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 (*1*). 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) (*1*).

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,

TABLE 1. Demographic and reproductive health characteristics among pregnant women — 6 provinces in China, 2014–2018.

Variables	Non-anemia (N=119,951) X̄±SD	Anemia (N=86,802) X̄±SD	Total (N=206,753) X̄±SD	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±3.05	39.12±2.35	39.09±2.78	−4.22	<0.001

Note: The six provinces (with the selected districts) are: Hebei (Xinhua and 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, so Tiedong County became the participant since then.
Abbreviation: ANC=antenatal care, Hb=hemoglobin.

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 (%)	x^2	Number	Prevalence of anemia (%)	x^2	Number	Prevalence of anemia (%)	x^2	Number	Prevalence of anemia (%)	x^2
Regions			242.45[*]			128.04[*]			916.09[*]			2614.20[*]
Northeast	14,581	4.62		36,875	43.05		24,881	80.85		76,337	48.03	
Central	37,018	8.56		22,646	43.12		24,372	69.60		84,036	35.58	
Southwest	17,478	8.29		12,918	48.53		15,984	78.33		46,380	43.64	
Age			34.23[*]			32.20[*]			179.53[*]			89.04[*]
<25	15,740	8.41		14,679	46.11		15,258	78.39		45,688	43.90	
25–35	47,196	7.24		50,312	43.51		43,475	76.16		140,983	41.44	
>35	5,875	8.75		7,155	43.48		6,207	69.79		19,252	41.38	
Education			143.29[*]			120.16[*]			72.80[*]			354.32[*]
Junior high or lower	25,983	8.94		25,151	46.33		26,946	77.72		78,080	44.72	
Senior high school	18,333	7.94		16,565	45.10		16,417	75.86		51,315	41.66	
University or above	23,139	6.08		30,098	41.83		21,252	74.41		74,489	40.02	
Parity			48.23[*]			2.33			3.49			306.23[*]
0	34,580	6.93		36,893	43.88		30,128	76.24		101,601	40.90	
≥1	28,712	8.40		34,345	44.45		34,264	75.61		97,321	44.78	
Number of ANC examinations			50.59[*]			1902.86[*]			2327.02[*]			1820.44[*]
<5	4,311	4.87		9,252	23.02		6,099	50.93		19,662	27.70	
≥5	64,766	7.85		63,187	47.13		59,138	78.62		187,091	43.48	
Number of Hb tests			85.19[*]			4731.27[*]			7043.13[*]			5764.56[*]
<3	13,552	5.77		20,676	23.97		15,388	50.79		49,616	27.32	
≥3	55,525	8.12		51,763	52.07		49,849	83.83		157,137	46.61	
Delivery week			6.12[†]			29.25[*]			114.35[*]			215.88[*]
<37 weeks	2,822	6.45		69,158	44.27		63,342	76.34		198,755	42.30	
≥37 weeks	66,255	7.71		3,281	39.47		1,895	65.70		7,998	34.03	

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). Taian stopped surveillance in 2016, and Tiedong County became the participant since then. 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.
[*] $p < 0.001$.
[†] $p < 0.05$.

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 3. Factors associated with anemia among pregnant women — 6 provinces in China, 2014–2018.

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	
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 (Yueyanglou 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.

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

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.

\# Corresponding author: Jiangli Di, dijiangli@chinawch.org.cn.

---

[1] National Center for Women and Children's Health, Chinese Center for Disease Control and Prevention, No.12, Dahuisi Road, Beijing, China.

REFERENCES

1. Kassebaum NJ, GBD 2013 Anemia Collaborators. The global burden of anemia. Hematol Oncol Clin North Am 2016;30(2):247 – 308. http://dx.doi.org/10.1016/j.hoc.2015.11.002.
2. Rahman MM, Abe SK, Rahman MS, Kanda M, Narita S, Bilano V, et al. Maternal anemia and risk of adverse birth and health outcomes in low- and middle-income countries: systematic review and meta-analysis. Am J Clin Nutr 2016;103(2):495 – 504. http://dx.doi.org/10.3945/ajcn.115.107896.
3. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet 2012;378(9809):2123 – 35. http://dx.doi.org/10.1016/s0140-6736(10)62304-5.
4. The State Council. Learning guidance book of "Development Outline for Chinese women (2011–2020)". 2020. http://www.gov.cn/zhengce/content/2011-08/05/content_6549.htm. [2020-01-20]. (In Chinese)
5. General Office of the State Council. National nutrition plan (2017–2030). 2017. http://www.gov.cn/zhengce/content/2017-07/13/content_5210134.htm. [2020-01-20]. (In Chinese)
6. Committee for the Promotion of Healthy China Action. Healthy China Action (2019-2030). 2019. http://www.gov.cn/xinwen/2019-07/15/content_5409694.htm. [2020-01-20]. (In Chinese).
7. World Health Orgnization. Nutritional anaemias: tools for effective prevention and control. Geneva: WHO Document Production Services, 2017. https://apps.who.int/iris/bitstream/handle/10665/259425/9789241513067-eng.pdf;jsessionid=ED10D6C18CD0085FF0A3C59F73D50129?sequence=1.
8. Lin L, Wei YM, Zhu WW, Wang C, Su RN, Feng H, et al. Prevalence, risk factors and associated adverse pregnancy outcomes of anaemia in Chinese pregnant women: a multicentre retrospective study. BMC Pregnancy Childbirth 2018;18:111. http://dx.doi.org/10.1186/s12884-018-1739-8.
9. Gebre A, Mulugeta A. Prevalence of anemia and associated factors among pregnant women in north western zone of Tigray, Northern Ethiopia: a cross-sectional study. J Nutr Metab 2015;2015:165430. http://dx.doi.org/10.1155/2015/165430.
10. Zhao SY, Jing WZ, Liu J, Liu M. Prevalence of anemia during pregnancy in China, 2012-2016: a Meta-analysis. Chin J Prev Med 2018;52(9):951 – 7. http://dx.doi.org/10.3760/cma.j.issn.0253-9624.2018.09.016. (In Chinese).
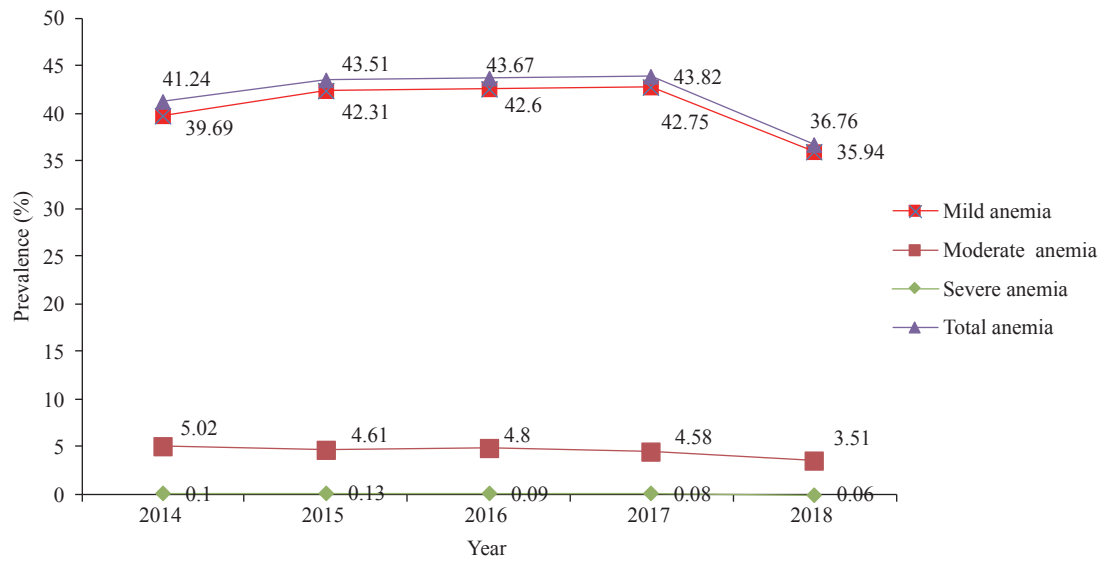
SUPPLEMENTARY FIGURE S1. Prevalence of anemia of different levels among pregnant women — 6 provinces in China, 2014–2018.