Changes in adverse pregnancy outcomes in women with advanced maternal age (AMA) after the enactment of China’s universal two-child policy

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The universal two-child policy (TCP; 2016) in China has affected many aspects of maternal-neonatal health. A tertiary hospital-based retrospective study (2011–2019) was used to find the association of these policy changes with maternal age and pregnancy outcomes in women with AMA (≥ 35 years) in the Hubei Province, China. The proportion of neonatal births to women with AMA increased by 68.8% from 12.5% in the one-child policy (OCP) period to 21.1% in the universal TCP period [aOR 1.76 (95% CI: 1.60, 1.93)]. In the univariate analysis, the proportion of preterm births (29.4% to 24.1%), low birth weight (LBW) (20.9% to 15.9%), and hypertensive disorders of pregnancy (HDP) (11.5% to 9.2%) significantly (p < 0.05) decreased in women with AMA from the OCP period to universal TCP period. However, the proportion of intrauterine growth restriction (IUGR) (0.2% to 0.7%) and gestational diabetes mellitus (GDM) (1.7% to 15.6%) was significantly (p < 0.05) increased over the policy changes. After adjusting for confounding factors, only the risk of GDM increased [aOR 10.91 (95% CI: 6.05, 19.67)] in women with AMA from the OCP period to the universal TCP period. In conclusion, the risk of GDM increased in women with AMA from the OCP period to the universal TCP period.

The Chinese government has been implemented an OCP since 1979, to control the rising population growth rate (540 million to 800 million during 1950–1970) and reduce the fertility rate1. This policy encouraged delayed childbearing, longer interpregnancy intervals, and fewer children which have stopped around 4000 million babies, and as a result, the birth rate has dropped significantly between 1.5 and 1.7 births per woman and has remained the same till now2. Meanwhile, the OCP had a profound impact on China’s population, societal, and health consequences, such as imbalance of sex ratio at birth, aging of the population, reduction of the workforce, and rising rate of C-section deliveries3-8.

In 2013, the Chinese government declared a partial TCP, allowing married couples to have a second child if either parent was a singleton. By easing certain restrictions in the OCP, the National Health and Family Planning Commission declared that the partial TCP would increase the supply of the workforce, reduce the aging population and sex-ratio imbalance. Following this, the Chinese government officially announced a universal TCP in October 2015, the 36-year OCP came to an end2. According to hospital surveillance data, the number of live births had increased to 17.86 million per year by 2016, reflecting a 7.9% increase over 20157. After the universal TCP, the number of deliveries with obstetric complications and the number of pregnant women with elder maternal age
increased. However, long-term studies to investigate the maternal and neonatal health consequences especially in women with the AMA after the implementation of TCP are limited. It has been estimated that after the universal TCP, an additional 90 million women in China will have a second child. Of these pregnant women, 60% are estimated to be older than 35 years, and 50% will be 40 years old. It is well-established that women aged 35 years or older had a significantly increased risk of preeclampsia (PE), placenta previa, and adverse perinatal outcomes. A retrospective study revealed that the trend of AMA increased in the Chinese population and was associated with higher odds of C-section, preterm births, low Apgar score, and perinatal mortality. Moreover, as a result of universal TCP, the expected increasing number of older pregnant women will pose an extra challenge for health caregivers and obstetricians and can further increase maternal-neonatal consequences.

The policy change has affected many aspects of China's population and maternal-neonatal health. Several studies have investigated the impact of universal TCP on maternal-neonatal outcomes. For example, the impact of birth policy changes on pregnancy outcomes, the sex ratio at birth, maternity care, maternal risk factors and pregnancy complications, C-section rate, women's reproductive decision, maternal-neonatal outcomes, and prevalence of congenital defects has been reported. However, limited studies have reported the effect of universal TCP on maternal age pregnancy outcomes in women with AMA. Therefore, we aimed to examine changes in maternal age and adverse pregnancy outcomes in women with AMA after the implementation of a universal TCP in Hubei province, China.

**Results**

**Changes in maternal characteristics and complications.** Among the total births (n = 23,051), 5653 births were in the OCP period (2011–2013), 8137 births in the partial TCP period (2014–2016), and 9261 births in the universal TCP period (2017–2019). The proportion of neonatal births to women aged < 30 decreased, whereas the proportion of neonatal births to women aged 30–34 years and women with AMA increased from OCP to universal TCP period. In total, 3956 (17.2%) births were to women with AMA. The proportion of births to multiparous women increased from 18.5% in the OCP period to 27.7% in the universal TCP period. Pregnancy complications including HDP, abnormal placentation, and GDM significantly increased over the policy changes (p < 0.05). Moreover, after adjusting for confounding factors, the risk of AMA significantly increased in the universal TCP period relative to the OCP period (Tables 1 and 2).

| Maternal age Characteristics | OCP period (2011–2013) N % | Partial TCP period (2014–2016) N % | Universal TCP period (2017–2019) N % | Cramer’s V | P-value |
|-----------------------------|-----------------------------|-----------------------------------|-------------------------------------|------------|---------|
| Total                       | 5653 100.00                 | 8137 100.00                       | 9261 100.00                         | --         | --      |
| <30                         | 3222 57.1                   | 4252 52.2                         | 3836 41.4                           | 0.09       | <0.001 (trend) |
| 30–34                       | 1716 30.4                   | 2584 31.8                         | 3475 37.5                           |            |         |
| ≥35 (AMA)                   | 705 12.5                    | 1301 16.0                         | 1950 21.1                           |            |         |
| Maternal Education          |                             |                                   |                                     |            |         |
| Low                         | 1432 25.3                   | 1926 23.7                         | 1584 17.2                           | 0.07       | <0.001  |
| Middle                      | 2241 41.8                   | 3226 39.6                         | 3607 38.9                           |            |         |
| Higher                      | 1980 35.1                   | 2985 36.7                         | 4070 43.9                           |            |         |
| Maternal occupation         |                             |                                   |                                     |            |         |
| Housewives                  | 3153 55.8                   | 4328 53.2                         | 4561 49.3                           | 0.03       | <0.001  |
| Professional services       | 2363 41.8                   | 3624 44.5                         | 4475 48.3                           |            |         |
| Manual workers              | 137 2.4                     | 185 2.3                           | 225 2.4                             |            |         |
| Parity                      |                             |                                   |                                     |            |         |
| Primiparous (≤ 1)           | 4606 81.5                   | 6181 76.0                         | 6696 72.3                           | 0.08       | <0.001  |
| Multiparous (> 1)           | 1047 18.5                   | 1956 24.0                         | 2565 27.7                           |            |         |
| C-section*                  | 3276 58.0                   | 5049 62.0                         | 5681 61.3                           | 0.03       | <0.001  |
| Previous history of C-section* | 366 6.5                   | 1234 15.2                         | 1993 21.5                           | 0.16       | <0.001  |
| HDP*                        | 313 5.5                     | 458 5.6                           | 725 7.8                             | 0.04       | <0.001  |
| Abnormal placentation*      | 187 3.3                     | 348 4.3                           | 480 5.2                             | 0.03       | <0.001  |
| GDM*                        | 41 0.7                      | 409 5.0                           | 1088 11.7                           | 0.17       | <0.001  |

Table 1. Changes in maternal characteristics from OCP (One-child policy) period to universal TCP (Two-child policy) period. *= Frequency and percentage of variables with only ‘Yes’ value presented, AMA (advanced maternal age) HDP (Hypertensive disorders of pregnancy composite of Gestational hypertension (GH), Preeclampsia (PE) and severe PE), Abnormal placentation (Composite of placenta previa and placental abruption), GDM (Gestational diabetes mellitus), p-values were calculated using chi-square test.
Changes in neonatal outcomes. The proportion of neonates with preterm births, LBW, low Apgar scores, fetal distress, and congenital defects significantly decreased from 19.2%, 14.2%, 3.3%, 4.2%, and 1.4% in the OCP period to 18.3%, 13.2%, 3.0%, 2.4%, and 1.0% in the universal TCP period, respectively. However, perinatal mortality and neonates with IUGR significantly increased (p < 0.05) from the OCP period to the universal TCP period (Table 3).

Changes in adverse pregnancy outcomes in women with AMA. Among adverse pregnancy outcomes in women with AMA, the proportion of preterm births, LBW, HDP, and C-sections significantly decreased from the OCP period to the universal TCP period. However, the proportion of IUGR (from 0.2% to 0.7%) and GDM (from 1.7% to 15.6%) significantly increased over the policy changes. Compared to the OCP period, after adjusting for confounding factors, the risk of GDM increased [aOR 10.91 (95% CI: 6.05, 19.67)] in women with AMA in the universal TCP period (Tables 4 and 5).

Discussion
In the present tertiary hospital-based retrospective study (2011–2019), we found changes in maternal age and adverse pregnancy outcomes in women with AMA after the implementation of the universal TCP. We observed that the proportion of neonatal births to women with AMA increased from the OCP period to the universal TCP period. The risk of AMA significantly increased in the universal TCP period compared with the OCP period. In the univariate analysis, among adverse pregnancy outcomes in women with AMA, the proportion of preterm births, LBW, HDP, and C-sections significantly decreased from the OCP period to the universal TCP period. However, the proportion of IUGR, fetal macrosomia, and GDM significantly increased over the policy changes. After adjusting for confounding factors, relative to the OCP period, the risk of GDM increased in women with AMA in the universal TCP period.

Our finding indicated a sharp increase (68.8%) in the proportion of women with AMA over the birth policy changes (from 12.5% in the OCP period to 21.1% in the universal TCP period). Although delayed childbearing has increased across the globe, the universal TCP in China might have encouraged the desire for a second child among older women. Based on the expected estimate, the universal TCP will encourage an additional 90...
million women to have a second child and among these women, 60% will be older than 35 years. In accordance with our findings, some studies in China reported the impact of universal TCP on maternal age. For example, Li et al. found that after implementing the universal TCP, around 5.40 million neonates were born between July 2016 and December 2017. During the study period, 9.1% and 5.8% monthly mean increase was found in multiparous mothers and mothers with AMA, respectively.

In Zhejiang Province, women with AMA increased from 8.52% in 2013 to 15.82% in 2017. A sharp increase was found in births to women with AMA from 2013 to 2017. The new China’s universal TCP may have increased the tendencies toward fertility desires among older women. These findings were also evidenced in the Chinese national surveillance data indicating that after the relaxation of OCP, women with AMA were increased from 7.8 to 10.9%.

In Beijing, after the enactment of universal TCP, women of older maternal age (≥ 40 years) increased significantly from 2.2 to 3.6%. In Hebei province, the proportion of pregnant women aged ≥ 30 years increased from 24.7% (in the OCP period) to 36.9% (in the universal TCP period). It indicates that the introduction of universal TCP encouraged women of old age to have a second child which was prohibited before the implementation of the birth policy change. We speculate that the increase in AMA could be in multiparous women.

### Table 4. Changes of adverse pregnancy outcomes in women with AMA over the period of policy changes.

| OCP period (2011–2013) | Partial TCP period (2014–2016) | Universal TCP period (2017–2019) | Cramer’s V | P-value |
|------------------------|-------------------------------|---------------------------------|------------|---------|
| N (705) | N (1301) | N (1950) |          |        |
| Preterm births | 207 | 336 | 470 | 24.1 | 0.04 | 0.02 |
| Perinatal mortality | 21 | 3.0 | 11 | 0.8 | 58 | 3.0 | 0.06 | <0.001 |
| LBW | 147 | 20.9 | 240 | 18.4 | 310 | 15.9 | 0.04 | 0.008 |
| IUGR | 2 | 0.2 | 7 | 0.5 | 14 | 0.7 | 0.02 | 0.03 |
| LPI | 33 | 7.4 | 58 | 4.5 | 75 | 3.8 | 0.01 | 0.5 |
| Low Apgar score | 34 | 4.8 | 77 | 5.9 | 71 | 3.6 | 0.04 | 0.009 |
| Fetal distress | 32 | 4.5 | 14 | 1.1 | 43 | 2.2 | 0.08 | <0.001 |
| Macrosomia | 35 | 5.0 | 73 | 5.6 | 109 | 5.6 | 0.01 | 0.04 |
| Congenital defects | 15 | 2.1 | 16 | 1.2 | 23 | 1.2 | 0.03 | 0.15 |
| HDP | 81 | 11.5 | 100 | 7.7 | 180 | 9.2 | 0.04 | 0.01 |
| Abnormal placentation | 44 | 6.2 | 93 | 7.1 | 122 | 6.3 | 0.01 | 0.5 |
| GDM | 12 | 1.7 | 113 | 8.7 | 305 | 15.6 | 0.17 | <0.001 |
| C-section | 518 | 73.5 | 1004 | 77.2 | 1400 | 71.8 | 0.05 | 0.003 |

### Table 5. Association between adverse pregnancy outcomes in women with AMA and policy changes.

| Adverse pregnancy outcomes | OCP period aOR (95% CI) | Partial TCP period aOR (95% CI) | Universal TCP period aOR (95% CI) |
|---------------------------|------------------------|-------------------------------|---------------------------------|
| Preterm births | 1.00 (reference) | 0.89 (0.73, 1.10) | 0.88 (0.72, 1.08) |
| Perinatal mortality | 1.00 (reference) | 0.31 (0.14, 0.64) | 1.25 (0.73, 2.14) |
| LBW | 1.00 (reference) | 0.94 (0.75, 1.19) | 0.88 (0.70, 1.11) |
| IUGR | 1.00 (reference) | 4.46 (0.55, 36.08) | 5.99 (0.76, 47.08) |
| LPI | 1.00 (reference) | 0.95 (0.61, 1.49) | 0.82 (0.53, 1.27) |
| Low Apgar score | 1.00 (reference) | 1.33 (0.87, 2.01) | 0.87 (0.56, 1.34) |
| Fetal distress | 1.00 (reference) | 0.24 (0.12, 0.45)* | 0.52 (0.32, 0.85)* |
| Macrosomia | 1.00 (reference) | 1.11 (0.73, 1.69) | 1.14 (0.76, 1.71) |
| Congenital defects | 1.00 (reference) | 0.66 (0.32, 1.36) | 0.70 (0.35, 1.39) |
| HDP | 1.00 (reference) | 0.69 (0.50, 0.94)* | 0.85 (0.63, 1.14) |
| Abnormal placentation | 1.00 (reference) | 1.16 (0.80, 1.69) | 1.06 (0.73, 1.53) |
| GDM | 1.00 (reference) | 5.53 (3.02, 10.01)* | 10.91 (6.05, 19.67)* |
| C-section | 1.00 (reference) | 1.19 (0.96, 1.47) | 0.83 (0.68, 1.01) |
multiparous women has increased from the OCP period to the universal TCP period, showing that women who previously had no plans to have an additional child during their childbearing age chose to have a second child.

Based on the evidence, the implementation of universal TCP has caused a significant increase in the proportion of elderly parturient women. These women of old age are likely to be associated with an increased risk of pregnancy complications such as, HDP, abnormal placentaion, GDM, C-section, and adverse perinatal outcomes. In the univariate analysis, we observed that in women with AMA, the proportion of preterm births, LBW, C-section, and HDP were significantly declined from the OCP period to the universal TCP period. Moreover, after adjusting for confounding factors, the risks of these adverse pregnancy outcomes in women with AMA were not significantly increased after the implementation of the universal TCP. Zhang et al. reported that HDP, placenta previa, placental implantation, and severe postpartum hemorrhage were significantly increased after the introduction of universal TCP compared with the OCP period. They believed that the increase in pregnancy complications could be due to AMA because a large number of older women became pregnant after the implementation of universal TCP and the proportion of women with AMA increased.

However, our univariate analysis showed that although the proportion of women aged ≥35 years increased but, the proportion of some adverse perinatal outcomes (i.e. preterm births, LBW), HDP, and C-sections were significantly decreased in women with AMA after the announcement of the universal TCP. The improvement of these pregnancy outcomes regardless of the impact of AMA could be attributed to improvement in socioeconomic status (SES), health sector initiatives, and investment in health care services. We observed that SES in women with AMA improved from the OCP period to the TCP period (table S1). Women of higher SES status were associated with a lower incidence of LBW in Shaanxi, China. Similar associations between maternal SES and pregnancy outcomes were reported in many previous studies.

The Chinese government has increased health expenditure per capita from US$ 53 in 1995 to US$ 480 in 2012 and achieved remarkable goals in the last two decades. To better deliver and manage the basic public health services, the Chinese government issued three editions of National Basic Public Service Specifications in 2009, 2011, and 2017, respectively. These service packages of the program consist of health education, health management of children aged 0–6, and maternal health care. Therefore, the strengthening and improvement of the three-tier medical and health services network for pregnant women in China has proven to decline the trends of adverse perinatal outcomes.

In the univariate analysis we showed that after the implementation of universal TCP, the proportion of GDM significantly increased in women with AMA. Moreover, after adjusting for confounding factors the risk of GDM significantly increased by tenfold in women with AMA in the universal TCP period. It is obvious that an increase in maternal age results in a higher incidence of GDM. In our findings, the proportion of GDM in women with AMA increased from 1.7% (in the OCP period) to 15.6% (in the universal TCP period). Zhang et al. also found that GDM increased from 23.1% (in the OCP period) to 25.3% (in the universal TCP period). However, their study did not report the proportion of GDM in women with AMA. A retrospective study conducted by Teng et al. examined changes in maternal age and pregnancy outcomes after the universal TCP. They reported that the incidence of GDM increased from 18.72% in 2015 to 25.59% in 2017. The proportion of GDM in women with AMA increased from 3.90% in 2015 to 5.48% in 2016 and then decreased to 0.35% in 2017.

AMA is an independent risk factor for GDM. As maternal age increases, the prevalence of GDM increases simultaneously. The prevalence of GDM in women aged <25 years, 25–29 years, 30–34 years, 35–39 years and ≥40 years, were 6.6%, 7.3%, 8.4%, 16.7%, and 35.2%, respectively. After adjusting for potential confounding factors, the risk of GDM increased with maternal age. In the Chinese population, women with AMA associated with a 3.6-fold increased risk of GDM. Moreover, in another Chinese population, women with AMA associated with a 3.6-fold increased risk of GDM. The higher risk of GDM in women with AMA could be explained by the progressive vascular endothelial damage in women of older ages, reduction in insulin sensitivity, impaired glucose tolerance, and deterioration of pancreatic β-cell function as maternal age increases.

Moreover, in our findings, the higher risk of GDM in women with AMA could be due to a sedentary lifestyle and higher body mass index (BMI). In general, women of professional services have higher tendencies of a sedentary lifestyle. In our findings, in women with AMA, the trend of professional services (i.e. doctors, nurses, accountants, teachers, lawyers, and actresses) increased from 27.1% in the OCP period to 49.1% in the universal TCP period (table S1). A sedentary lifestyle has become a significant problem across the globe and has been linked with a range of chronic health conditions including metabolic dysfunction and impaired blood sugar regulation. In the Brazilian pregnant women population, the sedentary lifestyle was associated with higher odds of GDM after adjusting for several confounding factors (aOR 1.9-fold). Similarly, in a population-based cross-sectional study the sedentary lifestyle was associated with a higher risk of GDM among Chinese pregnant women. The high BMI of pregnant women is associated with an increased risk of GDM. However, our study lacks data on the BMI of pregnant women which is one of the limitations of our study.

Our study had certain limitations which are worth mentioning. The study design was retrospective. Our data analysis is based on a single-center tertiary hospital, which is the potential selection bias in this study. We also excluded the women with chronic hypertension which could limit the generalizability of our findings. Moreover, we could not distinguish the C-section whether it was an elective or an emergency C-section. As a tertiary-level hospital, many pregnant women with severe pregnancy complications are transferred to our hospital, resulting in a relatively high C-section rate in women with AMA. Therefore, our results cannot be generalized to the whole population and pregnant women living in other regions of China.
Conclusion
In summary, the proportion of neonatal births to women with AMA increased from the OCP period to the universal TCP. The risk of AMA significantly increased in the universal TCP relative to the OCP period. After adjusting for confounding factors, the risk of GDM increased in women with AMA in the universal TCP period compared with the OCP period. As we were working on the impact of TCP on maternal age and adverse pregnancy outcomes in women with AMA, the Chinese government announced the tree-child policy39. Therefore, this study will help obstetricians and clinicians to pay serious attention to the increasing trend of AMA and associated adverse pregnancy outcomes after the three-child policy.

Material and methods
Study population. A tertiary hospital-based retrospective study was conducted in the Wuhan University Renmin Hospital, Department of Obstetrics and Gynecology, Hubei, China from January 2011 to December 2019. The data was collected and documented in the obstetrics register and electronic database by trained nurses during individual examinations in the Gynecology and Obstetrics Department. The study protocol was approved by the Ethical Review Board of Renmin Hospital (ID: WDRY2019–K034) in accordance with the Declaration of Helsinki. The need for informed consent, according to national legislation, was waived by the Ethical Review Board of Renmin Hospital because this was a retrospective cohort study.

Inclusion and exclusion criteria. A total of 23,051 singleton pregnant women were selected for the study. We excluded missing data on maternal age, pre-pregnancy body weight, neonatal gender, birth weight, birth length, and gestational age40. Pregnant women aged ≤ 18 years old, with chronic hypertension, and twin neonates were also excluded from the data analysis as shown in Fig. 1.

Collection of data on maternal traits. Data regarding maternal traits were collected from the obstetrics register including maternal age, parity, prepregnancy body weight, gestational age, education, occupation, and pregnancy complications. At the time of delivery, based on age, pregnant women were divided into three groups (i) < 30 years, (ii) 30–34 years, (iii), and ≥ 35 years. Gestational age was calculated by the date of the last known menstrual period and confirmed by ultrasound examination during the first and second trimesters. Based on education, they were classified as ≤ 8 years (low), 9–12 years (middle), and ≥ 13 years (higher). Maternal occupations were categorized as (i) housewives, (ii) professional services (doctors, nurses, accountants, teachers, lawyers, and actresses), and (iii) manual workers (farmers, waitresses, drivers, and factory workers).

Definition of pregnancy complications and perinatal birth outcomes. Gestational hypertension (GH) is defined as having blood pressure greater than 140/90 mmHg without proteinuria after 20th weeks of gestation41. PE is defined as elevated blood pressure 140/90 mmHg with proteinuria (albumin > 0.3 g in 24 h) after the 20th week of gestation42. Severe PE referred to having a blood pressure higher than 160/110 mmHg with proteinuria (albumin > 5 g in 24 h) after the 20th week of gestation43. Placenta previa is defined as suboptimal placental implantation near or over the cervical opening44. Placental abruption referred to the early separation of the placenta before childbirth45. Neonatal birth outcomes were recorded immediately after neonatal birth including birth weight in grams using an electronic infant scale, birth length in centimeter using a standard measuring board for the neonate. Preterm birth is defined as a neonate born before 37 completed weeks or fewer than 259 days from the first date of a woman's last menstrual period46. Perinatal mortality is defined as the combination of late fetal mortality (stillbirths) and early neonatal mortality (0–6 days of life)47. Fetal macrosomia is defined as birth weight ≥ 4000 g and LBW is defined as birth weight < 2500 g48. IUGR is defined as a condition of fetal growth that is below the 10th percentile for its gestational age and does not reach its genetically predetermined growth potential49. Apgar score was determined by evaluating the newborn baby on five simple criteria on a scale from zero to two, then summing up the five values obtained. Apgar score was recorded at 1 min and 5 min after birth. Apgar score was divided into two categories (i) low Apgar score (< 7), and (ii) normal Apgar score (≥ 7)50. Fetal distress is defined as a pathophysiological condition in which the fetus is suffering from insufficient oxygen supply51. The ponderal index was determined by weight in gm / (length in cm)3 × 100. The
A ponderal index between 2.5 and 3.0 was considered normal between 2.0 and 2.5 marginal, and a neonate with a ponderal index less than 2.0 was considered a low ponderal index (LPI)\(^5\). Congenital defects are defined as abnormalities in the structure of neonatal body parts that occur during intrauterine development\(^5\).

**Potential confounding factors.** Cofounding factors were selected based on previous literature which is associated with both exposure and perinatal birth outcome\(^4\). The confounding factors included in this analysis were maternal education, occupation, pre-pregnancy body weight (≤ 45 kg and ≥ 91 kg), parity, and neonatal gender.

**Statistical analysis.** The categorical and binary variables are presented as number (n) and percentage (%). We divided the study period into OCP (2011–2013), partial TCP (2014–2016), and universal TCP (2017–2019). Changes in maternal age and maternal-neonatal factors in women of AMA were estimated using chi-square tests. To estimate the effect size, Cramer’s V was used in chi-square tests. Trend analysis (chi-square tests) was used to estimate the change in maternal age over the time period of policy changes. Additionally, we restricted our analysis to women aged ≥ 35 years to know changes in pregnancy complications and adverse perinatal outcomes in women with AMA over the time frame of policy changes. Binary logistic regression analysis was used to calculate odds ratios (ORs) and 95% confidence interval (CI) to examine the association of universal TCP with the risk of changes in maternal age groups and risk of pregnancy complication and adverse perinatal outcomes in women with AMA, while the OCP period being defined as the reference period. \(P < 0.05\) was taken statistically significant. The data were analyzed using SPSS (Statistical Package for Social Sciences) for window version 22 (IBM Corporation, Chicago, USA).

**Ethics approval and consent to participate.** The study protocol was approved by the Ethical Review Board of Renmin Hospital (ID: WDRY2019–K034) in accordance with the Declaration of Helsinki.

**Informed consent.** The need for informed consent, according to national legislation, was waived by the Ethical Review Board of Renmin Hospital because this was a retrospective cohort study.

**Data availability**

All data analyzed during this study are included in this article.

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H.L, N & C.F: Conceptualization, Methodology, Software, Writing- Original draft preparation and Formal analysis., S.Y, I.U.H, S.M & G.N, S.K: Methodology, Data curation, Writing- Reviewing, Editing, N, S.Y, H.L: Validation, investigation, Visualization, Supervision.

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