

Socio-Demographic Characteristics and Outcomes of Pregnant Women Who Delivered Before and After Ending the One-Child Policy in China: A Comparative Study

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Abstract

Background: Recently, Chinese new fertility policy has received widespread public attention. However, there are limited studies on the comprehensive epidemiology of maternal and infant health with respect to the characteristic changes of childbearing women. In this study, we compared the changes in socio-demographic characteristics and pregnancy outcomes of childbearing women before and after ending the one-child policy in Zhejiang province of China.

Methods: This was a multicenter and cross-sectional study. Data were from three representative hospitals in Zhejiang province by stratified random sampling. Women who gave birth in November 2012-2014-2016 were recruited, according to the time of the change in fertility policy. We explored the differences in maternal sociodemographic characteristics and pregnancy outcomes.

Results: Totally, 11,718 women were recruited, including 3480-4044-4194 in November 2012-2014-2016 respectively. Results showed the proportion of women with advanced age, relative higher education, higher number of gravidity and parity, previous cesarean section and births in a provincial hospital increased over time. Of multipara, they were more likely to be over ≥ 35 years old, to give birth vaginally and to have pregnancy complications and multiple birth, particularly in 2016 than in 2012. Of those primipara, the proportion of women with advanced age remained stable during periods. Further, both the percentage of vaginal delivery and instrumental vaginal delivery were higher in 2014 and 2016 than in 2012. The same period, the proportions of pregnancy complications, and multiple births significantly rose, but stillbirth and birth decreased in 2014 than in 2012 among women who never delivered.

Conclusions: Some adverse pregnancy outcomes increased as some key characteristics of childbearing women changed after ending the one-child policy. It suggested that policy provider and medical staff to strengthen consistent healthcare regarding to changes in birth policy.

Background

China has the highest population in the world. A national family planning policy of “only one child” has been implemented since 1979 to balance the sudden increase in population with economic stagnation [1–2]. With rapid socio-economic development, China is confronted with enormous challenges from fertility decline, an aging workforce, and other related problems. In November 2013, the Chinese government announced the ending of the “only one child” policy, to be replaced by a “second child” policy. Concerning this new policy, couples were encouraged to have two babies if one parent was a singleton. However, the implementation of the new birth policy did not result in a massive surge in the population in a short period of time [2–3]. As a result, it was declared on October 2015 that all couples in China would be allowed to have two children as of 2016 [2]. In this state was pointed out the initiation of a universal two-child policy.

The influence of the replacement of the one-child policy with the universal two-child policy has received widespread public attention. Although the policy has provided all couples with equal birth privileges, China has broadening social polarization was created diverse reproductive knowledges. Accordingly, some researchers focused on the potential changes associated with population size, health, sex ratio, natural and the environment resources, etc. [3–5]. There are limited studies on the comprehensive epidemiology of maternal and infant health concerning the characteristic changes of childbearing women. Zhejiang province, which is located on the eastern coast of China and has been well developed economy, established the implementation of the new fertility policy. Increasing proportions of pregnant women with advanced superior age and women undergoing repeat cesarean sections were noticed during daily medical work. In this article, we compared the changes in sociodemographic characteristics and outcomes of pregnant women who delivered before and after ending the one-child policy in Zhejiang province of China for medical and policy assistance.

Methods

Study Population

The present study is based on three hospital-based cross-sectional surveys conducted between the years of November 2012-2014-2016, respectively, and also can be carried out the survey according to the changes in fertility policy. Three representative hospitals

in three regions of Zhejiang province were selected by stratified random sampling. The annual number of birth, maternal and child health care level were the determining factors of sampling. These were a university hospital (Women's Hospital of Zhejiang University), a municipal hospital (Jiaxing Maternal and Child Health Hospital), and a community hospital (Haining Maternal and Child Health Hospital). The major investigation was represented the tertiary, secondary and primary maternal and child health care, respectively. All women who delivered in the three hospitals during study periods were recruited, regardless of pregnancy outcomes.

The sample size variable was calculated by following a formula,

$$N = \frac{Z_{\alpha/2}^2 \sum N_i P_i (1 - P_i) / W_i}{N^2 d^2 + Z_{\alpha/2}^2 \sum N_i P_i (1 - P_i)}$$

Where, N is the sample capacity, α is test level (0.05). d is permitting deviation (0.03), P_i the estimated probability value, and W_i is the percentage for each level. In this study, the average cesarean section delivery rate was regarded as, P_i which was 0.4. W_i was equal to 0.5, 0.3, and 0.2 from the tertiary, secondary to the primary care level. According to the formula, the sample size in the tertiary, secondary and the primary care hospitals should be at least 1000, 600, and 400 persons. In this study, the sample size in each hospital was reasonable for the study. The inclusion process and actual number of the included subjects were shown in Fig. 1.

Data Collection And Definition

We conducted the survey using a questionnaire filled out by particularly trained medical staffs and all data were evaluated from hospital electronic medical records and maternal and child health care system in Zhejiang province. All the Information included maternal demographic characteristics, gravidity, parity, obstetrical predications, delivery mode, primary indications for cesarean section, pregnancy outcomes and neonatal health. Investigators in each participating hospital were responsible for data collection, data entry and quality control in their own hospital. Finally, all data were sent to the Women's Hospital, School of Medicine, Zhejiang University, where researchers conducted a second round of quality control assessment, summarization, and analysis.

Women were categorized to the overweight and obesity group if they had a pre-pregnancy body mass index (BMI) ≥ 25 kg/m². An abortion history was indicated that women had either miscarriage or artificial abortion during a previous pregnancy. Cesarean delivery undertaken after the onset of labor was defined as an emergency Cesarean section, usually for failure to progress, fetal distress, or intrapartum hemorrhage. The elective cesarean section was performed before the onset of labor for obstetric indications or at the request of the mother. Preterm delivery was defined as birth before < 37 weeks gestation. Low birth weight was considered for a birth weight under 2500 g. Stillbirth was defined as fetal death occurring at 28 weeks gestation or later. Pregnancy complications were diagnosed by a clinical doctor and included premature rupture of the membranes, gestational hypertension, gestational diabetic mellitus, and severe anemia.

In Zhejiang province, all women are routinely provided with at least five sessions of antenatal care during pregnancy, according to national guidelines. Women attend their first antenatal care session within the first trimester (between 11 and 14 weeks' gestation). During the second trimester (16–28 weeks' gestation), women are offered an antenatal care session every month. Then, they are required to have two antenatal care sessions during the third trimester. If the women were identified with abnormal indications, they received more antenatal care through the whole pregnancy and were transferred to the corresponding hospital to ensure maternal and infant safety.

Statistical Analysis

Data from this study were inputted into Epidata 3.1 and analyzed using SPSS for Windows version 20.0 software. Categorical data were presented as frequencies and percentages. Continuous variables were presented as a mean \pm standard deviation and compared using student t-test. A socio-demographics distribution change with time was compared by Chi-square test. The odds ratios (OR) and 95% confidence intervals (CI) were estimated to analyze the correlations between maternal age, delivery mode and pregnancy outcomes before and after ending the one-child policy. Data in 2012 were regarded as the correspondence referenced group. OR 1 meant 2014/2012 and OR 2 meant 2016/2012. Considered the potential confounders, we did stratified analysis by

maternal parity as maternal parity was strongly associated with policy changes. A *P* value of 0.05 was used as a cutoff for statistical significance.

Results

Sociodemographic Characteristics

A total of 11,718 women gave birth, including 3480 in 2012, 4044 in 2014, and 4194 in 2016 respectively. The mean age of childbearing women was 28.80±4.72 years old, ranging from 15~55 years old. In these results of sociodemographic characteristics in women during three periods were reasonably different time intervals. The proportion of women who aged ≥ 35 years old, received at least secondary education, were with gravidity ≥ 2 and parity ≥ 1, had a previous cesarean section, gave the baby in a provincial hospital increased over time; but the proportion of women who were overweight or obese and with abortion history decreased (Table 1).

Table 1. Comparison of sociodemographic characteristics

Variable	2012 (N= 3480)		2014 (N= 4044)		2016 (N= 4194)		<i>P</i>		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%			
	Maternal age ≥35	228	6.55	355	8.78	607		14.47	143.63
Education	≥Secondary	2380	70.50	2934	74.64	3051	75.74	28.35	<0.001
	Missing	104	—	113	—	166	—		
Gravidity	≥2	1803	51.81	2252	55.69	2672	63.71	117.61	<0.001
Parity	≥1	840	24.13	1451	35.88	2060	49.12	512.52	<0.001
Overweight or obese		2390	68.67	2752	68.07	2189	52.19	300.11	<0.001
Previous Cesarean section		380	25.03	688	42.47	868	49.60	132.89	<0.001
Abortion history		1363	39.17	1377	34.05	1465	34.93	23.86	<0.001
Delivery hospital	Provincial	1276	36.67	1625	40.18	2021	48.19	192.55	<0.001
	Municipal	1408	40.46	1557	38.50	1637	39.03		
	Community	796	22.87	862	21.32	536	12.78		

Mode of Delivery and Pregnancy Outcomes

General comparison

Table 2 displays the crude comparison of delivery mode and pregnancy outcomes. Overall, poor difference for distribution of delivery way was observed between 2014 and 2012. In specific vaginal delivery or cesarean section delivery, the rate of instrumental vaginal birth and emergency cesarean section increased in 2014 compared with 2012. In 2016, the proportion of elective cesarean section increased significantly than in 2012. Both the OR for stillbirth and birth defects decreased over time. A series of increasing OR values for pregnancy complications, multiple births, and low birth weight were only recorded in 2016 than in 2012 (Table 2).

Table 2. The general comparison of delivery mode and pregnancy outcomes over time

Variable		2012		2014		2016		OR1 and 95% CI	OR2 and 95% CI
		(N= 3480)		(N= 4044)		(N= 4194)			
		n	%	n	%	n	%		
Delivery mode	Vaginal	1962	56.38	2424	59.94	2444	58.27	1.16(1.06~1.27)	1.08(0.99~1.18)
	Cesarean section	1518	43.62	1620	40.06	1750	41.73		
Vaginal delivery	Instrumental	75	3.82	130	5.36	120	4.91	1.43(1.07~1.91)	1.30(0.98~1.75)
	Natural	1887	96.18	2294	94.64	2324	95.09		
Cesarean section	Emergency	719	47.36	903	55.74	690	39.43	1.40(1.22~1.61)	0.72(0.63~0.83)
	Elective	799	52.64	717	44.26	1060	60.57		
Pregnancy complications		854	24.54	1062	26.26	1326	31.62	1.10(0.99~1.22)	1.42(1.29~1.57)
Multiple births		71	2.04	102	2.52	211	5.03	1.15(0.81~1.62)	2.92(2.19~3.89)
Stillbirth		63	1.81	35	0.82	41	0.98	0.47(0.31~0.72)	0.54(0.36~0.80)
Low birth weight		239	6.87	297	7.34	424	10.11	1.08(0.90~1.28)	1.53(1.29~1.80)
Preterm birth		349	10.03	390	9.64	570	13.59	0.96(0.82~1.12)	1.41(1.23~1.63)
Birth defect		59	1.70	33	0.82	41	0.98	0.48(0.31~0.73)	0.57(0.38~0.85)
Missing		18		11		0			
Sex of infant	Girl	1647	47.33	1950	48.22	2017	48.09	1.03(0.94~1.13)	1.03(0.94~1.13)
	Boy	1817	52.21	2086	51.58	2164	51.60		
	Missing	16	—	8	—	13	—		

Stratified data measurements

Of women with at least one parity, they were more likely to be over ≥ 35 years old, had the higher proportion of vaginal delivery and pregnancy complications in 2016 than in 2012. On the specific cesarean section way, the percentage of elective cesarean section rate was increased in 2016 than in 2012. Moreover, occurrences in stillbirth dropped greatly over time (Table 3).

Table 3. Comparison of maternal age, delivery mode and pregnancy outcomes by stratified analysis (maternal parity ≥ 1)

Variable	2012		2014		2016		OR1 and 95% CI	OR2 and 95% CI	
	N=840		N=1451		N=2060				
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%			
Maternal age ≥35	150	17.86	278	19.16	522	25.8	1.09(0.88~1.36)	1.61(1.31~1.97)	
Delivery mode	Vaginal	373	44.40	659	45.42	1006	48.83	1.04(0.88~1.24)	1.20(1.02~1.40)
	Cesarean section	467	55.60	792	54.58	1054	51.17		
Vaginal delivery	Instrumental	8	2.14	11	1.67	20	1.99	0.77(0.31~1.94)	0.93(0.40~2.12)
	Natural	365	97.86	648	98.33	986	98.01		
Cesarean section	Emergency	195	41.76	372	46.97	345	32.73	1.24(0.98~1.56)	0.68(0.54~0.85)
	Elective	272	58.24	420	53.03	709	67.27		
Pregnancy complications		158	18.81	277	19.09	551	26.75	1.02(0.82~1.27)	1.58(1.29~1.92)
Multiple births		24	2.86	31	2.14	67	3.25	0.74(0.43~1.27)	1.14(0.71~1.84)
Stillbirth		21	2.50	16	1.10	20	0.97	0.44(0.23~0.84)	0.38(0.21~0.71)
Low birth weight		77	9.17	113	7.79	192	9.32	0.84(0.62~1.13)	1.02(0.77~1.34)
Preterm birth		113	13.45	167	11.51	277	13.45	0.84(0.65~1.08)	1.00(0.79~1.26)
Birth defect		14	1.67	14	0.96	19	0.92	0.57(0.27~1.20)	0.55(0.27~1.09)
Missing		7	0.83	5	0.34	0	0.00		
Sex of infant	Girl	390	46.43	694	47.83	45.73	45.73	1.05(0.89~1.25)	0.97(0.82~1.14)
	Boy	445	52.98	754	51.96	53.88	53.88		
	Missing	5	0.60	3	0.21	0.39	0.39		

Of those who never gave birth, the proportion of women with advanced age remained stable over time. Although the proportion of vaginal delivery increased over time, instrumental vaginal delivery was also more popular in 2014 and 2016 than in 2012. Emergency Cesarean section rate only increased significantly in 2014 than in 2012, and the proportions of pregnancy complications, and multiple births significantly rose in 2014 and 2016 than in 2012. Stillbirth and birth defect were less likely to be reported in 2014 than in 2012 (Table 4).

Table 4. Comparison of maternal age, delivery mode and pregnancy outcomes by stratified analysis (maternal parity <1)

Variable	2012 N=2640		2014 N=2593		2016 N=2134		OR1 and 95% CI	OR2 and 95% CI	
	n	%	n	%	n	%			
	Maternal age ≥35	78	2.95	75	2.89	85			3.98
Delivery mode	Vaginal	1589	60.19	1765	68.07	1438	67.39	1.41(1.26~1.58)	1.37(1.21~1.54)
	Cesarean section	1051	39.81	828	31.93	696	32.61		
Vaginal delivery	Instrumental	67	4.22	119	6.74	100	6.95	1.64(1.21~2.23)	1.70(1.24~2.33)
	Natural	1522	95.78	1646	93.26	1338	93.05		
Cesarean section	Emergency	524	49.86	531	64.13	345	49.57	1.80(1.49~2.17)	0.99(0.82~1.20)
	Elective	527	50.14	297	35.87	351	50.43		
Pregnancy complications		696	26.36	785	30.27	775	36.32	1.21(1.08~1.37)	1.59(1.41~1.80)
Multiple births		47	1.78	71	2.74	144	6.75	1.55(1.07~2.25)	3.99(2.86~5.58)
Stillbirth		42	1.59	19	0.73	21	0.98	0.46(0.27~0.79)	0.62(0.36~1.04)
Low birth weight		162	6.14	184	7.10	232	10.87	1.17(0.94~1.45)	1.87(1.51~2.30)
Preterm birth		236	8.94	223	8.60	293	13.73	0.96(0.79~1.16)	1.62(1.35~1.95)
Birth defect		45	1.70	19	0.73	22	1.03	0.42(0.25~0.73)	0.60(0.36~1.00)
Missing		11	0.42	6	0.23	0	0.00		
Sex of infant	Girl	1257	47.61	1256	48.44	1075	50.37	1.03(0.92~1.15)	1.11(0.99~1.25)
	Boy	1372	51.97	1332	51.37	1054	49.39		
	Missing	11	0.42	5	0.19	5	0.23		

Discussion

The one-child policy in modern China has profoundly affected the lives of approximately one-fifth of the world's population for nearly 35 years [1]. Following the change in birth policy from "only one child", through "second child," to "universal second child," we made a number of observations: (1) an increasing proportion of childbearing women with advanced age, better education, and higher gravidity and parity, repeat cesarean section at enrollment; (2) births at a university/(tertiary) hospital and by vaginal delivery increased over time; (3) and after adjusting for the confounders, the risk of pregnancy complications and multiple birth went up, especially after "universal second child".

The results of the present study revealed an upward trend in the proportion of women with advanced age over years. In 2016, 14.47% women who gave birth were 35 years or over, which was more than double the figure in 2012. This was consistent with our expectations as delayed childbearing has been prevalent globally [6–9]. In the USA, the maternal mean age exceeded 35 years; this accounted for 14.0% of the total number of singleton births in a single center study [7]. In Finland, 10.4% women with first delivery were aged 35 years or more according to Finnish national data [9]. In Germany, the corresponding proportion even arrived at 22% [10]. In China, the latest national percentage of mothers over 35 years of age was 8.56%, whereas, which was based on data in 2007 [11]. By stratified analysis, this point was of significantly immense among the women who gave birth, which was mostly supported the hypothesis of the new policy entitled more elder women to have further births.

The increase in the proportion of women with better education agreed with a large-sample survey in China revealed that the highly educated women were strongly in favor of raising a second child [12]. Higher education might bring higher income, which makes a plan for two babies more affordable and realistic, as reported in Europe [13]. Moreover, the majority of women with inadequate education came from rural areas, where the one-child policy was not enforced so strictly. Therefore, the changes in birth policy

might not affect their fertility desire greatly. The relationship between policy transfer and body mass index categories was positive. A good education might encourage women to maintain an optimal weight gain during pregnancy.

These results suggested that a high cesarean section rate and a large scale of previous cesarean section as the primary indicator. In the present study could be reflected somewhat influences of the rising cesarean section in all socioeconomic regions in China before [14]. Our cesarean section rate (around 40%) was far greater than the global level (18.6%), based on latest data from 150 countries, but less than the overall cesarean section rate (54.9%) in mainland China in 2011, based on a multicenter, and large-sample study [15–16]. Notably, the cesarean section rate even arrived at above 50% among women who gave birth, which was much higher than the correspondence data generally in Taiwan (26.0%), Germany (24.0%) and younger childbearing women in Columbia (36.9%), but approximately the same as for data in Iran (44.6–53.1%) [10, 17–19]. A higher number of gravidity and parity, the rising proportion of elder mothers, multiple births, and pregnancy complications might led to it. In the face of variations in different studies, changes in the social and cultural background, maternal age distribution, legal frameworks, and medical technology should also be considered more carefully. Before the introduction of the second-child policy, the maternal request was the commonest indication of cesarean section in China [16]. Fortunately, in china government and institution integrated intervention in enhancing antenatal care and avoiding cesarean sections, especially unnecessary cesarean sections. Of primiparas, the cesarean section rate was decreased naturally over time.

The results of the present survey revealed an increasing number of deliveries in a university hospital over years. On the one hand, being awareness of healthcare led more women to seek care in a high-level hospital. On the other hand, a rising proportion of pregnancy complications were a more important determinant. A higher risk of pregnancy complications might arise from a combination of advanced maternal age, repeat cesarean section, and higher gravidity and parity as documented. In Victoria, Australia, older women giving birth, regardless of whether they were nulliparous or multiparous, were at higher risk of obstetric morbidities, with odds ratios ranging from 1.58 to 2.44 [9]. In China, data for 39 hospitals indicated that women over 35 years had a higher risk of a wide series of pregnancy complications than women aged 25 ~ 29 years [20]. The optimal maternal age at delivery is suggested at 26 ~ 30 years [22]. Women with cesarean section were more likely to develop major pregnancy-associated diseases, for instance, preeclampsia, gestational hypertension and hemorrhage, in a subsequent pregnancy than women who had delivered vaginally [22–23]. Meanwhile, higher number of gravidity and parity had a positive association with coronary heart disease, metabolic syndrome, and Cesarean section [24–25]. The most frequently presented complications of pregnancy in present study were premature rupture of the membranes, gestational hypertension, gestational diabetic mellitus, and severe anemia. In turn, these above integrated factors increased the risk of low birth weight and preterm birth. With changes in fertility policy in China government and hospitals have taken great measures to ensure mother and infant safety. This might be linked to with decreased stillbirths. Moreover, more efforts were put on prevention of congenital defects this contributed to the decreasing malformations to some extent.

Strengths And Limitations

The strengths of this study is that we have provided a comprehensive discussion of the changes in the sociodemographic characteristics and outcomes for pregnant women before and after the ending of the one-child policy in China. The adjustment of reproductive policy has been received much interest in China. In this multicenter study, childbearing women in three different hospitals, represented from a tertiary hospital to a basic hospital. This greatly reduced the selection bias. To avoid confounding factors, we did the stratified analysis. The result is beneficial for medical decisions and policy analysis. Some limitations should be acknowledged when interpreting the results. First, there were no detail data on women with early adverse pregnancy, such as miscarriage. Thus, we could not make a considerable estimate of all pregnancy outcomes. Second, China is a country with largest economic and healthy development variations. As the data were based primarily on women living in East Coast of China, the results could only provide a reference.

Conclusions

In conclusion, in the present study indicates that some adverse pregnancy outcomes, increased as some key characteristics of childbearing women changed after ending the one-child policy. In consideration of it, effective public health strategies for further reducing adverse pregnancy should be advocated as birth policy transferred.

Abbreviations

BMI

body mass index; OR:odds ratio; CI:confidence intervals

Declarations

Ethics approval and consent to participate

This was an observational study which had been approved by the ethics review board of Women's Hospital, School of medicine, Zhejiang University (Ethic approval number: 2017-0012). This hospital is also a provincial hospital for maternal health in Zhejiang. We only used secondary data from routinely datasets as maternal health care system. All information was kept confidential. Informed consent has been obtained from these women. In addition to this, we confirm that all methods were performed in accordance with the guidelines and regulations.

Consent to publish

No individual personal data; hence not applicable

Availability of data and materials

The datasets are available from the corresponding author on reasonable request.

Competing interests

No conflict of interest

Funding

Not applicable

Authors' contributions

XZ, HL, XT, XC conceived and designed the study. XZ analyzed the data and drafted the paper. HL, XT, XC contributed to collect data and help finish the study. All authors reviewed and approved the final manuscript.

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Figures

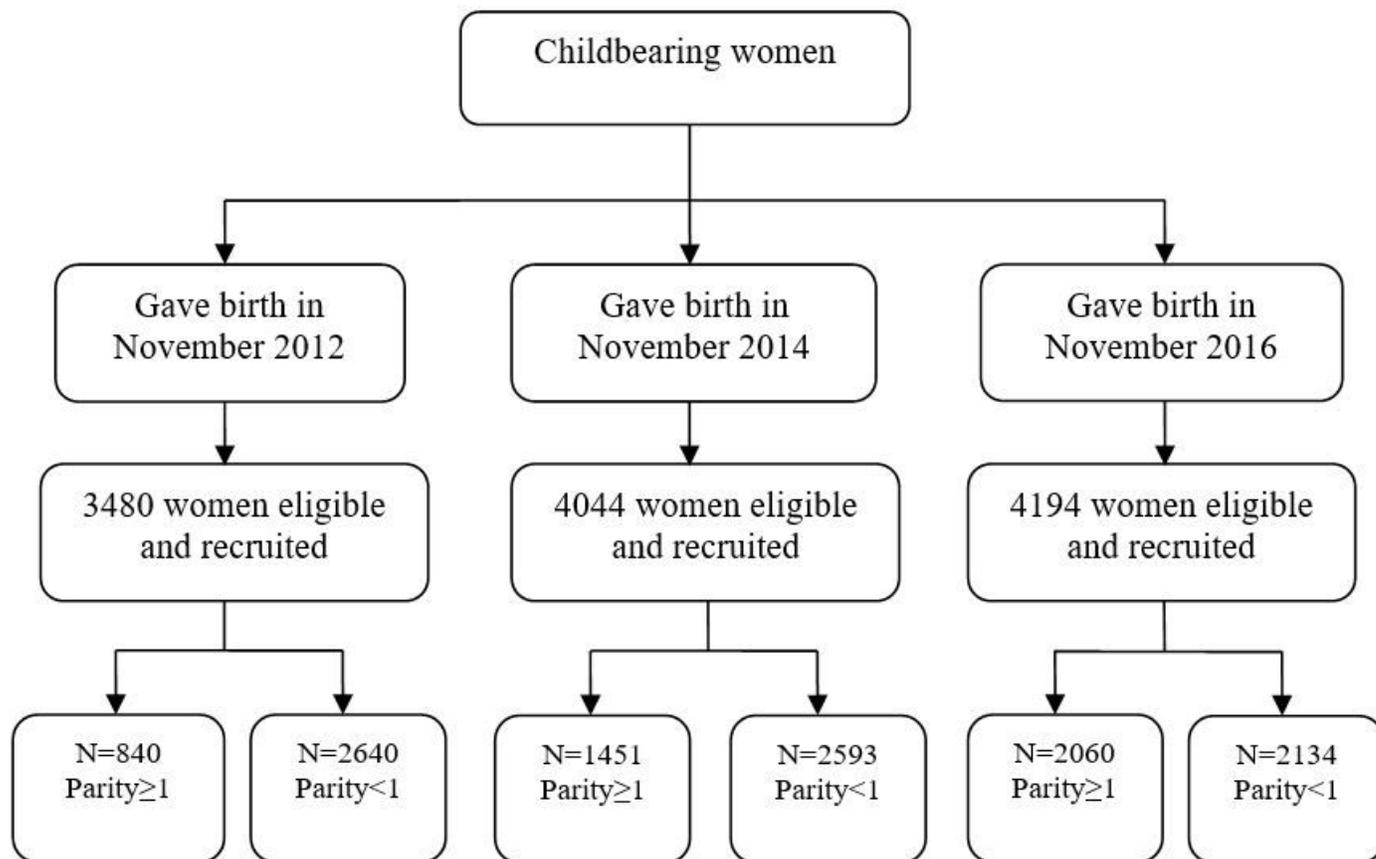


Figure 1

The inclusion process and actual number of the included subjects were shown in Figure 1.