

Recent sex ratio at birth in China

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To cite: Jiang Q, Zhang C. Recent sex ratio at birth in China. *BMJ Global Health* 2021;**6**:e005438. doi:10.1136/bmjgh-2021-005438

Handling editor Sanni Yaya

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjgh-2021-005438>).

Received 22 February 2021
Revised 30 April 2021
Accepted 3 May 2021

ABSTRACT

Background China's sex ratio at birth (SRB) has declined in the past decade but still exceeds the normal level. This study seeks to depict the SRB trend in the past two decades.

Methods We depicted the SRB trend, including SRB by birth order, children composition, residence and hukou type, education, race and province using latest data available from multiple data sources and standardisation and decomposition methods.

Results The SRB remained around 120 in the first decade from 2000 to 2010, and recently declined and approached the normal level during 2010–2020. The SRB for second births and first births converged to the normal level, whereas the SRB for third and above births exceeded the normal level. The rising proportion of second births increased, whereas the decreasing proportion of first births reduced the overall SRB. Parents with only daughters are more likely to abort a female fetus in pursuit of a son, while parents with only sons are more likely to abort a male fetus in pursuit of a daughter. It also shows difference in SRB by residence, hukou type, educational attainment and race. Urban SRB was lower than rural SRB, by the residence and hukou type, but higher than rural SRB after being standardised. Provinces still exhibit differences by original categorised policy even after the implementation of the universal two-child policy.

Conclusions China's SRB has declined substantially during the past two decades, but the negative effects need to be tackled.

INTRODUCTION

Traditionally, Chinese people favoured sons over daughters in the deeply entrenched patrilineality, patriarchy and patrilocal family system. Son preference and less preference for daughters were prevalent throughout Chinese history, infanticide of female children is one embodiment of such preference, resulting in a large number of missing women.¹ Since the 1980s, with the implementation of China's stringent birth control policy and with the simultaneous decline in fertility intention and behaviour due to socio-economic change, it was impossible to realise son preference of having at least one son by extra births, so Chinese people turned to sex-selective abortion to ensure a son and led to an abnormally high sex ratio at birth (hereafter SRB, expressed as the number of live

Key questions**What is already known?**

- China's sex ratio at birth (SRB) has been very high for a long time, it declined and then stabilised as indicated by the data from recent annual population sample surveys.
- The SRB varied with factors like birth order, children composition, educational attainment, hukou type and so on.
- Prior studies mainly used data by 2010.
- Most recent trends are seldom introduced.

What are the new findings?

- We provide the most recent SRB trend in China with multiple data sources.
- The SRB roughly stabilised at a very high level during 2000–2010, declined and stabilised a little bit above the normal level during 2010–2020.
- Children composition is an important determinant for the gender of next births.
- The SRB is higher than the normal level for parents with only daughters(s), and lower for parents with only son(s), indicating a sex-selective abortion of both female and male fetuses.
- The SRB varied with factors like birth order, children composition, residence, hukou type, educational attainment, race and province.
- We provide a relatively comprehensive introduction to SRB trend by these factors.
- By decomposition, the SRB change by birth order and the children composition change contributed differently to the overall SRB change.
- By standardisation, urban SRB is higher than rural SRB.

What do the new findings imply?

- China's SRB will further decline.
- When tackling China's SRB, besides the regulations and countermeasures, factors mentioned in this paper should be taken into consideration.

male births for 100 female live births). China's 1982 population census indicates the SRB was 107.63, slightly higher than the generally accepted normal range of 102–107 live male births for 100 female births. The SRB further rose to 111.45 in 1990, and 119.92 and 121.21 in the 2000 and 2010 population censuses, respectively.² Female infanticide,³ adoption of girls without registration,⁴ under-reporting of female births⁵ and sex-selective abortion of



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female fetuses^{5,6} were all listed as reasons for China's high SRB. Sex-selective abortions contributed significantly to the rise in SRB.² The high SRB and its related consequences have been numerously debated.

After 2010, the SRB in China began to decline. However, the recent SRB trend has been underexamined due to the unavailability of data from other sources, concentrated focus on China's steady low fertility and the steep decline in the number of births despite adopting the universal two-child policy. China's annual population sample survey has been the main source for depicting the recent trend of SRB, but this source is not so reliable without comparing it with other data sources as the annual population sample survey accounts for only one per thousand of the total population. Some studies have tried to elucidate the recent SRB trend with data from 120 county monitoring system (120 CMS) and from China's recently established birth registration system (BRS) in China.⁷ This paper examined the trend of SRB over two decades, from 2000 to 2020, according to indicators of the SRB for all births and births by order, the SRB by children composition, the SRB by standardisation and decomposition, the SRB by residence, hukou type, educational attainment, ethnic groups and by province. With the latest data from China's census, mini-census and annual population sample survey, data from 120 CMS and data from the recently established BRS, we expect to provide a systematic introduction to the SRB trend in recent years, and to explore the reasons behind this change. The remainder of this paper is structured as follows: in the second section we introduce the Chinese context including the birth control policy and SRB, then we introduce the data source and method employed. In the fourth section we present the results, the fifth section concludes this paper.

The Chinese context

The birth control policy

The Chinese government adopted a pronatalist attitude following the foundation of the People's Republic of China in 1949. Subsequent population growth alerted the government the importance of birth control, but the political context in the 1950s and 1960s, such as the Great Leap Forward and the Cultural Revolution, hindered the implementation of strict birth control.⁸ Realising the necessity of integrating population growth and its control into economic planning, China promulgated the 'later, longer, fewer' policy in 1973. 'Later' represented late marriage; 'longer' stood for longer birth intervals; and 'fewer' meant fewer children. In late 1970s, Deng Xiaoping emphasised the potential contribution of limiting population growth to economic development goal,⁹ which was replaced in 1980 by a one-child policy after the delivery of An Open Letter to All Members of the Communist Party and Communist Youth League—on the Issue of Controlling the Population Growth by the CPC Central Committee. Urban residents with non-agricultural hukou readily complied with the one-child

requirement in a planned and quoted economy, but rural residents with agricultural hukou opposed this policy, which led to less strict implementation.⁸ The policy evolved into the one-child policy in the urban areas and a '1.5-child policy' (rural couples whose first child was a girl were permitted to have another child) in most rural areas.¹⁰

As a state policy stipulated in China's Constitution, China's birth control policy has been localised, exhibiting urban-rural difference as well as intraprovince difference. In China, there has been a hukou (household) registration system linked with benefits and social stratification.^{11,12} China's birth control policy was closely related to the hukou system, too. In the three decades from the late 1980s to 2013, whereas urban residents with non-agricultural hukou were permitted to have one child, in practice the policy for rural residents with agricultural hukou fell into several categories: (1) One-child policy. In six provinces including Beijing, Tianjin, Shanghai, Chongqing, Jiangsu and Sichuan, almost all residents are expected to follow the one-child policy per couple. (2) '1.5-child policy'. This has been the dominant policy in the majority of 19 provinces of China's 31 provinces, where rural residents with agricultural hukou are allowed to have a second child after a specified birth interval if the first birth is a girl. (3) Two-child policy. In five provinces including Hainan, Ningxia, Qinghai, Yunnan and Xinjiang, all rural couples with agricultural hukou are allowed to have two children.¹⁰ Besides, ethnic minority groups were permitted to have two or more children, enjoying a less strict birth control policy compared with Han Chinese.

The stringent birth control policy has been relaxed. In 2013, the Chinese government decided to relax the above policy and adopted a selective two-child policy, namely couples that either spouse was an only child could have a second birth regardless of residence or hukou type.¹³ However, the relaxation failed to bring about the expected baby boom, so the Chinese government replaced the selective two-child policy with a universal two-child policy, which did not affect births and fertility markedly.

Son preference and the SRB

Traditionally, China practised a strict patrilineality, patriarchy and patrilocal system. In such a system, men were dominant in wealth inheritance, living arrangements, family line continuity and intrahousehold power structure, and women were submissive to men. Compared with daughters, sons could economically provide farm labourers in the agricultural society, provide social security support to aged parents, culturally carry on the family line and enhance the family status in the community.^{14,15} According to the Confucianism, of the three most unfilial practices, having no male offspring is the biggest. The preference for sons has been prevalent throughout Chinese history.

In the strong son preference context, the SRB was higher than normal with the implementation of the stringent birth control policy.¹⁶ Traditionally, Chinese people realised their son preference and children composition by extra births. Due to the birth constraint by the policy, people turned to sex-selective abortion of female fetuses to ensure having a son. As fertility drops, couples who want to have at least one son must increasingly rely on sex selection.¹⁷ A fertility decline would bring about a sex selection pressure and a subsequent rise in SRB.¹⁸ In the 1980s and 1990s, the stringent implementation of birth control policy accounted for the majority of the rise in the SRB.¹⁹ A survey in a central China village conducted around 2000 indicates that about 25% of female fetuses were aborted, whereas only 1.6% of male fetuses were aborted.²⁰ Since the early 1980s, China had both imported abroad and produced domestically a large volume of ultrasound B machines, and there had equipped good-quality ultrasound B machines and skilled technicians in each county by the early 1990s. Hospitals and individually-run clinics had the incentive to make money. Still, there were black-market sex identification services.²¹

The birth control policy has strengthened the son preference.²⁰ The 1.5-child policy stimulated son preference and prenatal sex identification, which produced seriously abnormal sex ratios. According to China's 2000 census, the SRB in one-child policy areas was 111.6, lower than the SRB of 124.7 in 1.5-child policy areas but higher than that in two-child policy areas.²² In provinces granting a quota of 1.5 or two births per couple, sex-selective abortions were seldom used for the first birth, but couples relied heavily on sex-selective abortion for the second pregnancy if their first-born was a daughter.

The relaxation of the birth control policy was expected to bring about a more normal SRB.²³ However, birth control relaxation should not be considered to be a sovereign remedy for the normalisation of SRB. The long-standing son preference, differential stopping rules and so on should be emphasised when tackling the highly skewed SRB.⁵ SRB may take many years to normalise due to the long-standing preference for sons and continued access to sex-selective technologies.²³

Combating high SRB has been a priority in family planning work all the time. The Chinese government has been advocating gender equality and improving female social status, and devoted to the cracking down on illegal sex identification and illegal sex-selective abortions, incurring heavy punishments on practitioners of sex-selective abortion.²⁴ Provisions in Article 35 of the 12th Five-Year Plan (2011–2015), stipulates that population-related work be holistically fulfilled, and the abnormally high SRB trend be curtailed. With this goal in the national 5-year plan, a local provincial 5-year plan would include detailed terms to combat sex-selective abortion in achieving that outlined goal. In 2014, Hubei province investigated and dealt with 1132 typical cases of 'two illegals', punished 422 doctors who were involved, revoked

the license of 90 doctors, fired 42 people and punished 80 people for criminal offences.²⁵

Recently, son preference has weakened. After several decades of high SRB, marriageable females are in shortage, and this shortage increased their social status. Women enjoy a strong bargaining power in intrahousehold decisions in such a marriage market.^{26 27} Surveys in China have shown that in recent years women enjoyed an increasing social status, especially in rural areas due to the difficulty and the high cost for rural men to get married.²⁸ Skyrocketing brideprice and marriage expense,²⁹ marriage apartment paid by the groom's family³⁰ deplete the wealth of the groom's family. As women can marry up to prosperous areas, males, especially rural males at the bottom of social strata, are squeezed in the marriage market and have to remain single. In rural Shandong province where son preference is quite strong, rural parents are labelled into three classes. The first class is parents with only daughter(s), the second class is parents with one daughter and one son, the third class is parents with two sons.²⁸ Added values of women due to this shortage will weaken son preference and normalise SRB.²³

Alongside the demographic factor are the socioeconomic factors to weaken son preference. The values of sons and daughters tend to be equal when a country reaches a high level of modernity, urbanisation.³¹ The social and economic transformation,^{17 31} especially the rapid increase of female educational attainment, employment and participation in social affairs, increases women's social status. Exposure to modern ideas would reduce women's preference for sons.³² The strong son preference is waning and the skewed SRB would return to normal.

METHODS

Data

There are several sources for SRB data. The first and most commonly used is the population census and annual population sample survey conducted by China's National Bureau of Statistics (NBS). One major concern about the SRB in census data by NBS is the sex-selective under-reporting of female births in the form of concealment or unregistered adoption. The births registered in the annual population sample surveys, which accounted for 1 per 1000 of the total population, amounted to 10 000–20 000 for the calculation of SRB. The number of births in the 2018 and 2019 annual population change surveys is 12 493 and 11 425, respectively, not large enough to calculate the SRB at the province level due to the small sample size. Some attempts have been made to assess the contribution of under-reporting to elevated SRB, but there is no consensus.^{5 21} Because of the complete coverage, ready availability and authoritativeness provided by the NBS, this set of SRB data is still widely employed to reflect the trend of SRB in China.

Another large and reliable data source, which has been employed recently,⁷ is the 120 CMS. This system

was intended to provide information on population dynamics, first established in 2008 by the National Health and Family Planning Commission (NHFP), terminated and replaced in 2018 by other monitoring systems. It collected individual demographic information and recorded population dynamics, including births, marriages and deaths. Data were tabulated at the village, township and county levels. The latest available 2016 data cover 117 counties in 28 provinces excluding Zhejiang, Yunnan and Tibet, and include a total population of 128.4 million, accounting for 9.4% of China's total population.⁷ The number of births registered in this system for 2012–2015 is 1.19, 1.06, 1.12 and 0.95 million, respectively. Previous research has proved the overall good representativeness of these data.³³ In this paper, we used birth history in this 120 county data to calculate the SRB by children composition, education and race.

Still there is a newly established BRS in China. This system, established by the NHFP in 2014 and ideally expected to cover the total China population, collected data from the real-name registration system for new births by health departments. Since 2014, the newly established BRS started to provide updated information on births by collecting information on the date of birth, sex, place of birth and the demographic information of parents of each live birth. But this data set collected only information of newly births and had no birth history of parents. We used this data set to depict the latest trend in SRB and SRB by hukou type. Compared with the population census, hospital records have been more in line with the actual sex of live births because doctors do not change the record of baby's sex or conceal the birth of any baby. Therefore, the SRB reflected by the BRS data is expected to be more accurate and reliable. The annual number of births for 2015–2020 in this data set is more than 10 million.

With the multiple data sources, including population censuses, mini-censuses, annual population sample surveys, the 120 CMS and the BRS mentioned above, we present a panorama of China's SRB in the past two decades.

Method

Decomposition

The decomposition method proposed by Jiang *et al* is as follows.³⁴ Let M , m_1 , m_2 and m_3 denote numbers of all male births, male births for the first, second, third and above orders, respectively; and F , f_1 , f_2 and f_3 denote numbers of all female births, female births for different birth orders. Use P_1 , P_2 and P_3 to denote the proportion of female births for the first, second, third and above orders to the total number of female births in the period, $P_1 = \frac{f_1}{F}$, $P_2 = \frac{f_2}{F}$, $P_3 = \frac{f_3}{F}$, use SRB , SRB_1 , SRB_2 and SRB_3 to denote the SRB for all births and births of the first, second, third and above orders.

$$SRB = \frac{M}{F} \times 100 = \frac{f_1}{F} \times \frac{m_1}{f_1} \times 100 + \frac{f_2}{F} \times \frac{m_2}{f_2} \times 100 + \frac{f_3}{F} \times \frac{m_3}{f_3} \times 100 = \sum_{i=1}^3 P_i \times SRB_i$$

Let superscripts x and y denote different points in time. The decomposition of changes in total SRB can be denoted as follows:

$$SRB^x - SRB^y = \sum_{i=1}^3 (P_i^x \times SRB_i^x - P_i^y \times SRB_i^y) = \sum_{i=1}^3 \frac{P_i^x + P_i^y}{2} \times (SRB_i^x - SRB_i^y) + \sum_{i=1}^3 \frac{SRB_i^x + SRB_i^y}{2} \times (P_i^x - P_i^y)$$

where $\sum_{i=1}^3 \frac{P_i^x + P_i^y}{2} \times (SRB_i^x - SRB_i^y)$ denotes the effect of variations in SRB by birth order on the change in total SRB, and $\sum_{i=1}^3 \frac{SRB_i^x + SRB_i^y}{2} \times (P_i^x - P_i^y)$ denotes the effect of compositional changes of female births by birth order.

Standardisation

Goodkind standardised rural and urban sex ratios by birth order to the total birth order distribution in the corresponding year for China as a whole,⁵ and other benchmarks for standardisation can be chosen. Under any standard, the standardised excess of urban ratios above rural ratios will always hold. In this paper, we standardised the rural and urban sex ratios by birth order to the total birth order distribution in the corresponding year for China as a whole. The formula of this standardised SRB is as follows:

Let the superscript u denote urban areas, then with the above notations, the standardised SRB for urban areas equals:

$$StdSRB^u = \frac{\sum_{i=1}^3 (M^u + P^u) \times \frac{m_i + f_i}{M + F} \times \frac{SRB_i^u}{SRB^u + 100}}{\sum_{i=1}^3 (M^u + P^u) \times \frac{m_i + f_i}{M + F} \times \frac{SRB_i^u}{SRB^u + 100}} \times 100$$

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

The SRB trend

Figure 1 presents the trend of SRB for the total population with data from population censuses, mini-censuses and annual population sample surveys, and with BRS data, as well as SRB by birth order with BRS data. The SRB fluctuated around 120 during the first decade of the 21st century. During the decade, China implemented a stringent birth control policy.¹⁰ Though the effect of this birth control policy on the SRB had been reappraised,^{35 36} the entrenched son preference, combined with the restriction on the number of births, made sex-selective abortion of female fetuses quite common,^{2 31} leading to an abnormally high SRB.

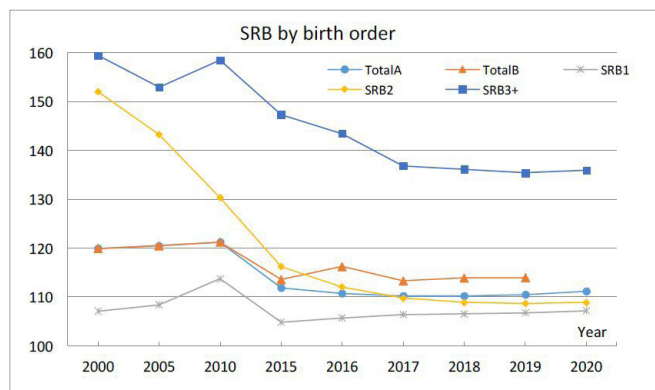


Figure 1 Sex ratio at birth (SRB) by birth order since 2000. Data source: data for 2000, 2005 and 2010 are from population census and mini-census; data for 2015 and afterwards in Total A and for SRB1, SRB2 and SRB3+ are from birth registration system (BRS). Data for 2015 and afterwards in Total B are from 2015 mini-census and annual population sample surveys. Total A or Total B represents the SRB for all births in one data set. SRB1, SRB2 and SRB3+ represent the SRB for births of first order, second order, and third and above orders, respectively.

The SRB, however, declined steeply between 2010 and 2015. The reason for this drastic decrease was multifaceted. First, the regulation combating sex-selective abortion and high SRB was tightened. Second, the relaxed birth control to a selective two-child policy adopted in 2014 accompanied the successive dramatic decline in SRB in 2014 and 2015. Third, the discriminatory circumstances against adult males in the marriage market and marriage expenses, especially in rural areas, have reversed the strong son preference.²

The SRB in China stabilised around 110 after 2015. In 2016, the universal two-child policy was adopted, and it had an impact on SRB decline as predicted.²³ Coupled with the universal two-child policy is the attitude change towards children. Though son preference still prevails, it wanes, and daughter preference is rising.³⁷ China would follow its neighbouring countries such as South Korea in the trajectory of SRB decline.^{38,39} Optimistically, we will observe a further decline in and normalisation of SRB soon.

SRB by birth order

One characteristic of China's SRB is the divergence by birth order. As presented in figure 1, before 2010, the SRB for first births was relatively normal, 107.12 in 2000

population census, and 108.41 in 2005 mini-census. However, the SRB for second, third and above births was astonishingly high. The reason for that was people would turn to sex-selective abortions at second or above birth order.²⁰ However, in 2010, the SRB for first births was much higher, too. With the genuine decline in fertility intention, parents with son preference, who formerly realised their son's preference with extra births, turned to sex-selective abortion for first births.³⁶

The SRB for first and second births recently converged to the normal level after 2015. Despite the remarked divergence between SRB for first and second births, the SRB for second births declined markedly, approaching the normal level. The universal two-child policy,²³ the waning son preference and increasing preference for daughters^{2,37} all contributed to the decline in SRB for second births.

The SRB for third and above births remains very high. Son preference, though waning, is still prevalent in China. Those who fail to have one son via the first two children would turn to sex-selective abortion for the third birth. However, the proportion of third births accounted for only 5.88%, 6.55% and 12.48% in 2000, 2010 and 2020, respectively. That is why with the decline in the SRB of second births, the total SRB approached the normal level, though the SRB for third births remains very high.

Decomposition of SRB change by birth order

To examine the order-specific contribution to the SRB change, we decomposed the decline magnitude into the effect of SRB change by birth order and the compositional change (female birth order distribution) with the above-mentioned decomposition method. The result is presented in table 1.

The result shows that, for the increase of 1.29 in SRB from 2000 and 2010, the rise in first-order SRB increased the total SRB, but the decline in the proportion of first births reduced the total SRB. During this period, there was no influential birth control relaxation, so the change in the compositional change can be attributed to the postponement of marriage and first childbearing for young people. The age at first childbearing was postponed from 24.50 in 2000 to 26.65 in 2015, while the total fertility rate for first births dropped from 0.87 to 0.73.⁴⁰ The SRB for second births declined and reduced the total SRB, and the proportion of second births contributed markedly to a rise of 10.28 to the total SRB. The total fertility rate for

Table 1 Decomposition of SRB change

Year	Difference of SRB	Effect of SRB change by birth order				Effect of compositional change			
		First	Second	Third+	Sum	First	Second	Third+	Sum
2000–2010	1.29	4.51	−5.71	−0.05	−1.25	−8.73	10.28	0.98	2.54
2010–2020	−10.04	−3.50	−8.09	−1.89	−13.49	−23.27	18.53	8.20	3.45

Data source: calculated from 2000 and 2010 census data and 2020 birth registration system (BRS) data. SRB, sex ratio at birth.

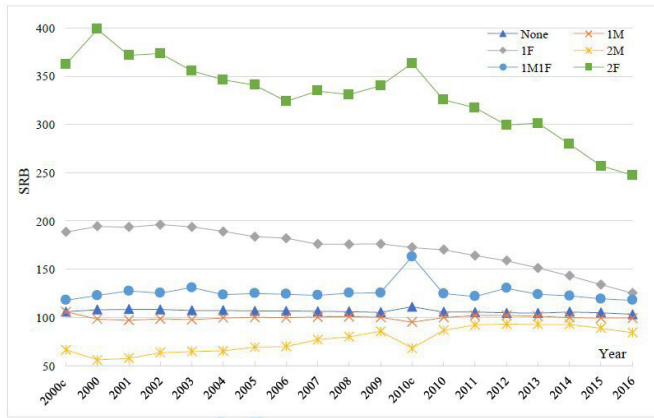


Figure 2 Sex ratio at birth (SRB) by children composition. Data source: 2000c and 2010c represent 2000 and 2010 census. Data for other years are calculated from 120 county monitoring system (CMS) data. The legends represent existent children. M represents son and F represents daughter. 1M means the mother has already had one son.

second births increased from 0.29 to 0.38, whereas that for the first births dropped.⁴⁰

From 2010 to 2020, the SRB for all birth orders declined and reduced the total SRB. The dramatic decline in the first-order proportion and the rise in the second-order proportion contributed markedly but inversely to the total SRB. With further postponement in marriage and child-bearing, the age at first childbearing rising to 27.24 in 2020 from 26.65 in 2010, the number and the proportion of first births dropped significantly during 2010–2020. In contrast, the proportion of second births increased noticeably due to universal two-child policy adoption.

SRB by children composition

Figure 2 presents the SRB by children composition. China’s 2000 and 2010 census data indicate that the next SRB for parents with only one or two daughters was much higher, and the next SRB for parents with only one or two sons was lower than the normal level. One neglected phenomenon is the sex-selective abortion of male fetuses.^{5 7 21 41} With the data from 120 CMS, we presented the temporal trend of SRB by children’s composition. Consistent with the result from the census data, for parents with only one son, the SRB was lower. Parents with only two sons were much lower than the normal, indicating the potential adoption of sex-selective abortion of male fetuses to ensure a daughter. It has been well documented that Chinese parents prefer sons, but the majority regard it ideal to have both a son and a daughter in the current low fertility situation.⁴⁰ However, when the universal two-child policy replaced the one-child policy, it was found that parents had little enthusiasm for a second child due to the high cost of childrearing both in terms of money and time.^{42–45} Especially, there is a fear to have two sons, and the two-son composition is the least preferred. The intention and the likelihood to have a second child are lower if the first is a son.³⁷ For those who have only sons and pursue the next birth, a daughter is preferred.

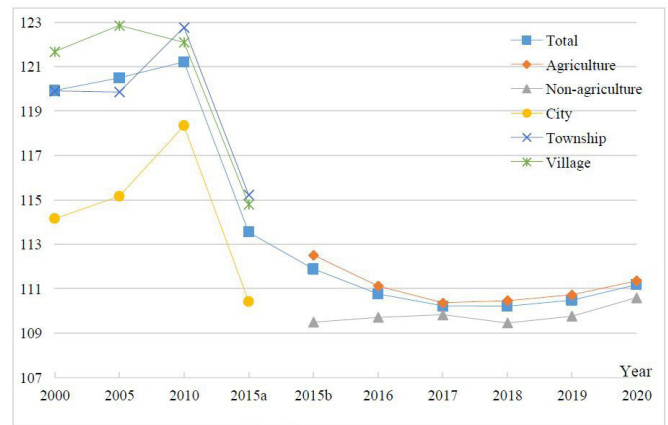


Figure 3 Sex ratio at birth (SRB) by residence and hukou type since 2000. Data source: data for 2000, 2005, 2010 and 2015a are from census and mini-census; data for 2015b and afterwards are from the birth registration system (BRS) data.

For parents with two sons who have the next birth, almost one-third of the next sons were aborted, as indicated in the SRB of 70.

For parents with only daughters, the SRB for the next birth was much higher. For parents with only one daughter, the SRB was higher. For parents with only two daughters, the SRB was extremely higher, indicating the strong desire for a son. But the SRB for the next birth gradually declined over the period, indicating a waning son preference. It seems that the use of sex-selective abortion is to realise having both a son and a daughter, rather than simply for realising son preference.

SRB by the residence and hukou type

The SRB exhibits differences by residence and hukou type, as indicated in figure 3. In the first decade 2000–2010, the SRB for city, township and village populations exceeded the normal level of 106, with a noticeable difference. In the population census and mini-census, people were enumerated according to their residence, regardless of their hukou registration. The SRB was lower for city and township residents than that of their village counterparts.

A recent convergence of SRB for the population with non-agricultural and agricultural hukou was observed after 2010, along with the relaxed two-child policy. Both SRB for non-agricultural population and SRB for agricultural population declined greatly, approaching the normal level, and the gap between the two was narrowing.

From the fact that the overall SRB for the rural population was higher than that for the urban population, it was generally regarded that urban residents, who were generally more educated and decently employed, were less son preferring and less likely to turn to sex-selective abortion than rural residents. However, if we compare the corresponding order-specific SRB for the urban and rural populations, there was not much difference, or urban SRB was even higher than rural SRB by birth order, as indicated in figure 4.

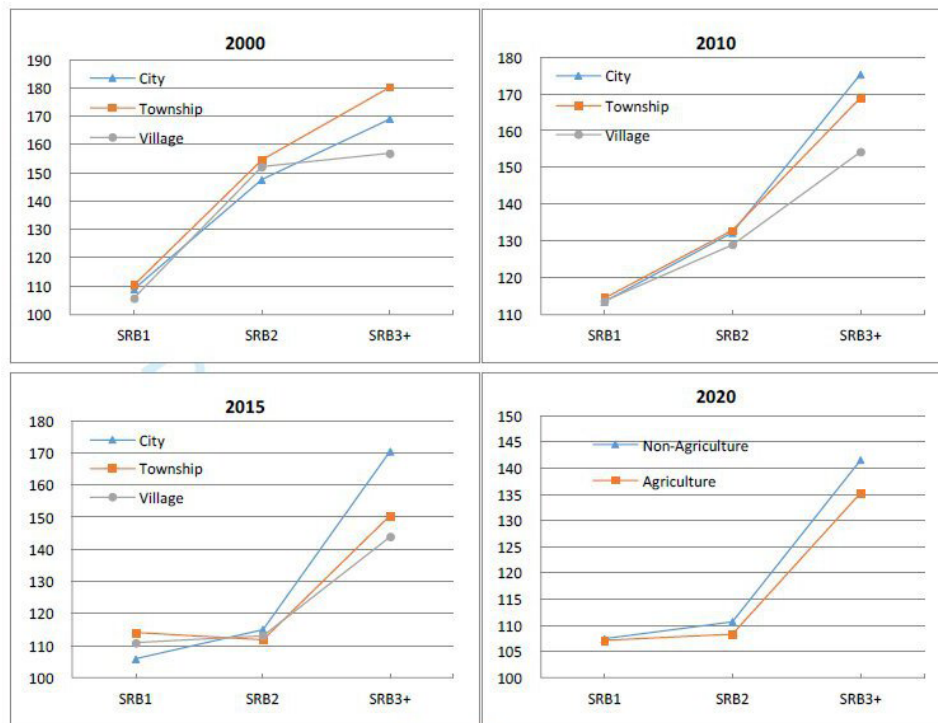


Figure 4 Sex ratio at birth (SRB) by residence (or hukou type) and birth order. Data source: data for 2000, 2010 and 2015 are from census and mini-census; data for 2020 are from birth registration system (BRS) data.

The almost equality of order-specific SRB between urban and rural populations, and the discrepancy in overall SRB for the urban and rural populations, resulted from the children composition by birth order. Compared with their rural counterparts, urban people had a smaller proportion of second and above-order births due to a stricter birth control policy. As indicated in the 2000 census data, the proportion of first births to total births in 2000 was 85.00%, 76.61% and 61.44% for city, township and village population, respectively, and the proportion of second births was 13.31%, 19.80% and 31.02%, respectively. Due to the large share of second births for the rural population and much higher SRB for second births, the overall SRB for the rural population was higher than that for the urban population. To eliminate the effect of children composition by birth order, Goodkind standardised the urban and rural SRB for 2000 and 2005 data, and got a

reverse comparison result, indicating a stronger propensity of urban parents to use sex selection.⁵ We standardised the data for the population with non-agricultural and agricultural hukou for 2015–2020 with BRS data to the total population's birth order distribution in the corresponding year. As indicated in table 2, before standardisation, the agricultural SRB was higher than non-agricultural SRB. After the standardisation, the non-agricultural SRB became higher than the agricultural SRB.

SRB by education

Figure 5 presents the SRB by education for different birth orders. The SRB for first births was relatively normal for mothers of different educational attainment, and the SRB for second, third and above birth orders was much higher for mothers of any education. By comparison, the

Table 2 Reported and standardised SRB for 2015–2020

Year	Reported			Standardised		
	Agricultural	Non-agricultural	Difference	Agricultural	Non-agricultural	Difference
2015	112.51	109.49	3.02	111.84	111.53	0.31
2016	111.12	109.70	1.42	110.54	111.17	-0.63
2017	110.36	109.82	0.54	109.88	110.91	-1.04
2018	110.46	109.46	1.00	109.97	110.81	-0.84
2019	110.72	109.76	0.96	110.18	111.46	-1.28
2020	111.36	110.59	0.76	110.80	112.69	-1.88

Data source: calculated from birth registration system (BRS) data. SRB, sex ratio at birth.

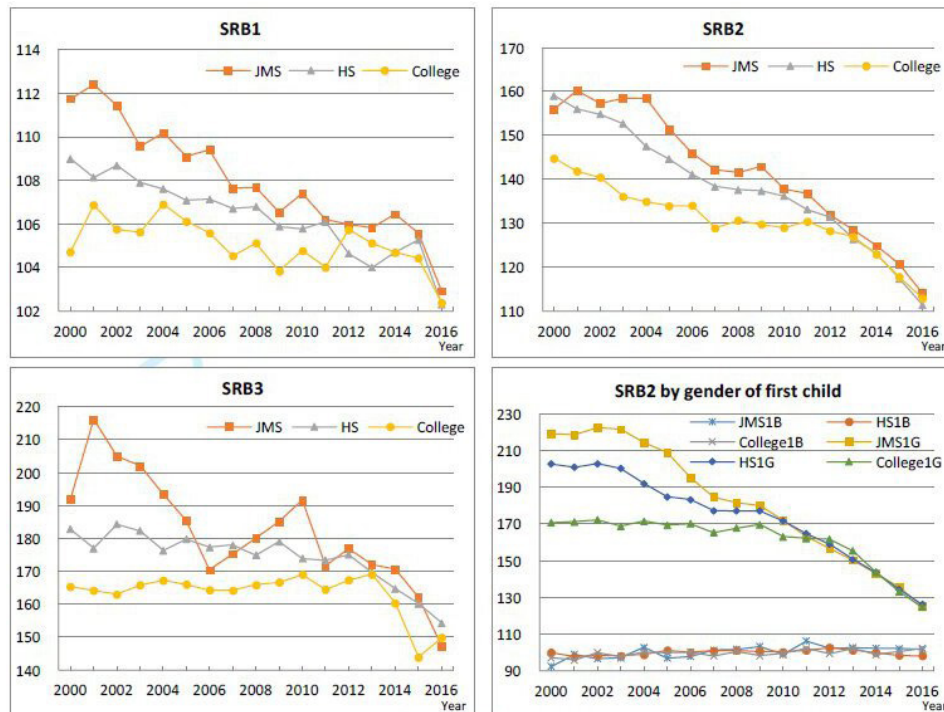


Figure 5 Sex ratio at birth (SRB) by education. Data source: calculated from 120 county monitoring system (CMS) data. JMS represents junior middle school or below, HS represents high school or equivalent, College represents college or above. 1B and 1G mean the first child is a boy or a girl.

SRB was relatively higher for mothers of lower education, but the SRB converged towards the normal level gradually. If the first child was a girl, the SRB for second child-births by lower educated mothers was much higher than that for second child-births by higher educated mothers. In comparison, if the first child was a boy, there may be sex-selective abortions of male fetuses for second births, but there was not much difference among groups with different educational attainment.

SRB by race

Figure 6 presents the SRB for Han Chinese and ethnic minorities by birth order and by the gender of the first birth. The SRB for both Han Chinese and ethnic minorities was consistent with the national trend, namely the SRB for first births was relatively normal, and the SRB for second, third and above births was higher. By comparison, the SRB for Han Chinese was much higher than that for ethnic minorities. Han Chinese and ethnic minorities had different birth control policy, as ethnic minorities had a more loosened policy which permitted them to have two or more children. As for the SRB by the gender of the first child, both Han Chinese and ethnic minorities had high SRB if the first-born was a girl, while the SRB for Han Chinese was much higher than that for ethnic minorities. If the first-born was a boy, then the SRB for both Han Chinese and ethnic minorities was lower than the normal level, indicating a sex-selective abortion of male births for both Han Chinese and ethnic minorities.

SRB by province

China consists of more than 30 provinces. It exhibits remarkable differences in both socioeconomic development and demographic indicators. We presented SRB for different provinces over the past two decades in figure 7.

In the 2000 census, 11 provinces fell in the 112–120 range of SRB, and another 12 provinces exceeded 120. In 2010, the SRB of 28 provinces was greater than 112, of which 13 exceeded 120. The provinces with a high SRB were mainly concentrated in the central and southern regions of the country. After 2015, according to the BRS data, the number of provinces with a normal SRB increased, while the number of provinces with SRB imbalance decreased.

It has also been proven that the population with the 1.5-child policy had the highest SRB.²² We present the SRB for the births in provinces grouped by original fertility policy, categorised into three types in figure 8. Over the years, the SRB was the highest for the population in provinces with the 1.5-child policy, followed by that in provinces with the one-child policy, and that in the two-child policy provinces was lowest. However, it was still higher than normal. Even after the one-child policy was replaced by a selective two-child policy in 2013 and a universal two-child policy in 2016, the provinces with originally 1.5-child policy still had the highest SRB, especially Fujian, Anhui, Jiangxi, Hunan and Hubei provinces. In these mentioned provinces, the sex ratio for second births was still severely imbalanced after the implementation of the universal two-child policy. Furthermore, the SRB of second births was higher for non-agricultural households than agricultural households.

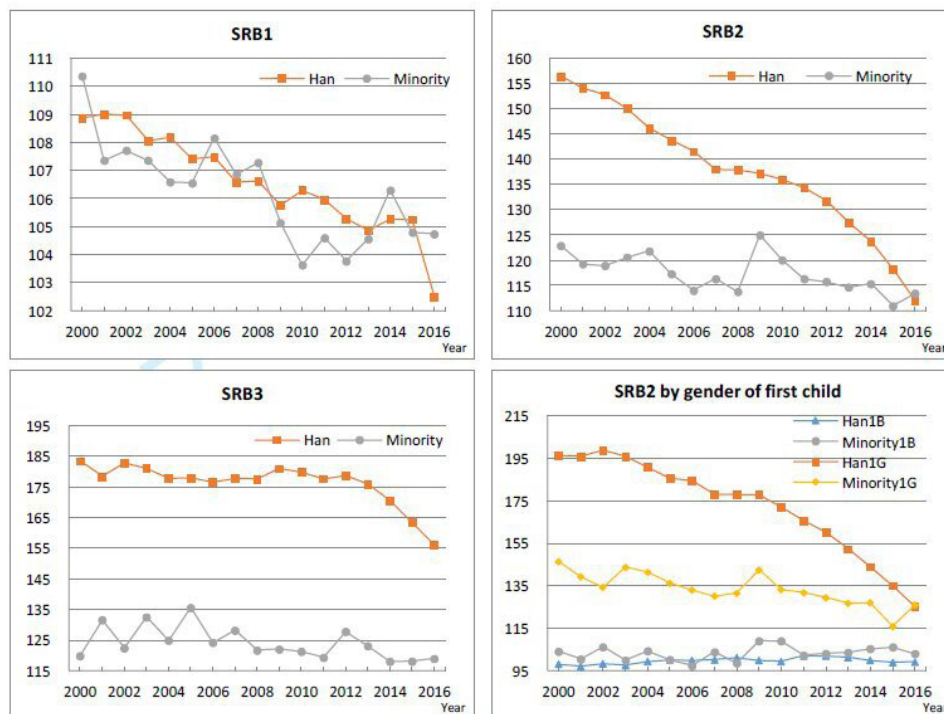


Figure 6 Sex ratio at birth (SRB) by race. Data source: calculated from 120 county monitoring system (CMS) data. Minority includes all other ethnic groups excluding Han Chinese. 1B and 1G mean the first child is a boy or a girl.

A universal decline can be observed over the years. With the universal two-child policy, the SRB has declined and approached the normal level,⁴⁶ but the difference by fertility policy area still existed.

DISCUSSIONS

High SRB is a worldwide issue⁴⁷ and is most prominent in China, intertwining with stringent birth control policy and the simultaneous decline in fertility level. With the

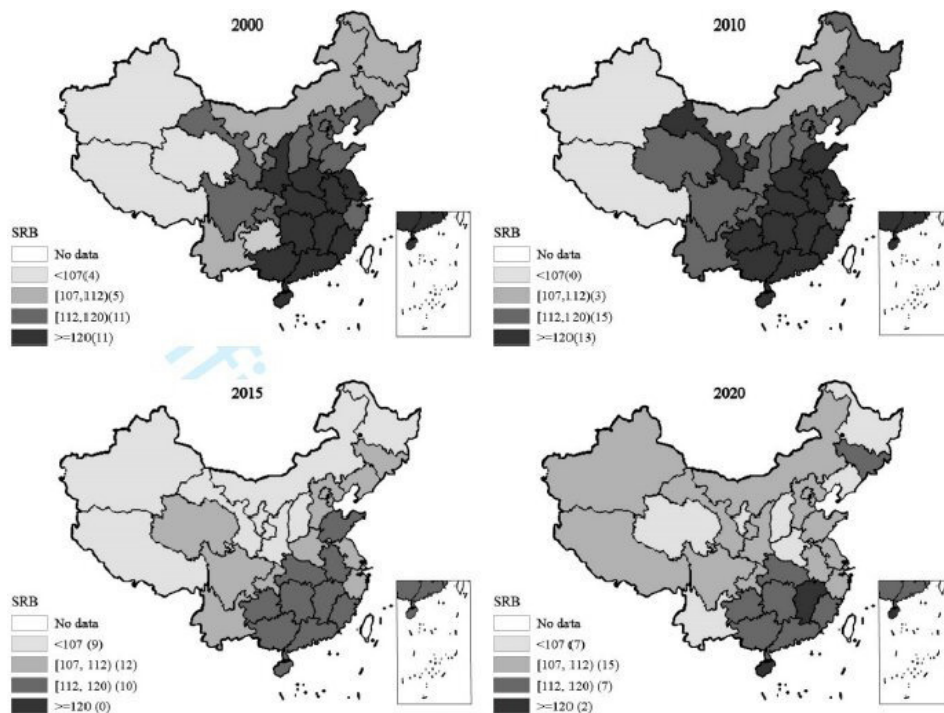


Figure 7 Sex ratio at birth (SRB) by province. Data source: data for 2000, 2010 and 2015 are calculated from census and mini-census; data for 2020 are calculated from birth registration system (BRS) data.

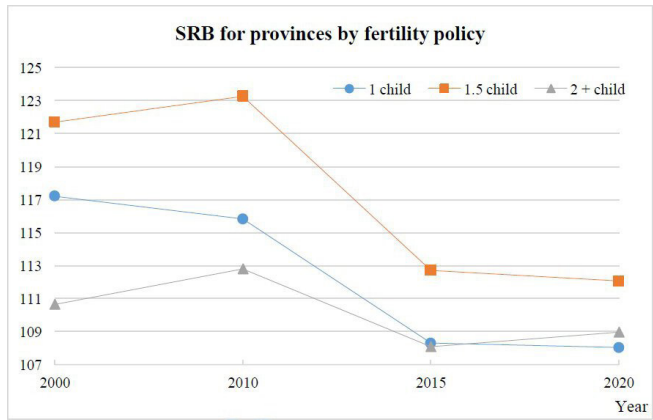


Figure 8 Sex ratio at birth (SRB) for provinces by fertility policy. Data source: data for 2000 and 2010 are calculated from the corresponding census; data for 2015 and 2020 are calculated from birth registration system (BRS) data.

latest available data, we analysed China's SRB trend over the past two decades. The findings are as follows.

SRB remained around 120 in the first decade from 2000 to 2010, and recently declined and approached the normal level in the decade of 2010–2020. The government's holistic countermeasures at all levels, the basic attitude towards son preference and the universal two-child policy all contributed to the decline over the past decade 2010–2020. By birth order, the SRB for second births and first births converged to the normal level, whereas the SRB for third and above births exceeded the normal level. As the third births accounted for just a small proportion of total births, the overall SRB declined markedly, approaching the normal level.

Decomposition by birth order shows that the rising proportion of second births increased, whereas the decreasing proportion of first births reduced the overall SRB. The SRB for first births initially rose and then declined, contributing inversely in the first and second decades. The decline in SRB for third births reduced the overall SRB, especially in 2010–2020, whereas the rising proportion of third births increased the overall SRB. Because of the postponement in marriage and childbearing, the first births declined in proportion. In contrast, the proportion of second and above birth orders rose markedly, especially with the universal two-child policy. However, the policy's potential inertia of second births has been fully released, and the new estimate of China's births was around 12 million. Foreseeably, China's second birth proportion will decline soon.

SRB by children composition confirms the abortion of female fetuses by parents with only daughters, especially with only two daughters, in pursuit of a son. Previously, the abortion of male fetuses has not been adequately discussed,^{5 7 21 41} this paper shows that the abortion of male fetuses did occur for parents with only daughters. Son preference still prevails, but is weakening. People regard it ideal to have a son and a daughter and fear having two sons in the current situation.

Generally, urban SRB was lower than rural SRB, by residence and by hukou type. Recently, both urban SRB and rural SRB converged, approaching the normal level. However, consistent with Goodkind for 2000 and 2005 SRB standardisation,⁵ standardised urban SRB was higher than that of the rural population by hukou type for 2015–2020. Goodkind posited that this did not necessarily suggest a stronger son preference of urban residents, but at least a stronger propensity to use sex selection.⁵ If we compare the order-specific SRB for urban and rural populations, urban SRB by birth order is higher than the corresponding rural SRB. The difference in the overall SRB for urban and rural populations resulted largely from the compositional differences in birth orders. It may be prudent to ascertain that the rural population is more inclined to sex selection.

Increasing educational attainment reduced the SRB in China. More educated mothers had a lower SRB than less educated mothers, though for second and above orders the SRB was still well above the normal level. Well-educated mothers generally hold the gender equality ideology and have less preference for sons over daughters. As the educational attainment level increases in China with the rapid socioeconomic development and education expansion, we can optimistically predict that China's SRB will decline from the perspective of increasingly educated mothers.

Regarding the SRB difference by race, Han Chinese had a higher SRB than minority groups. Generally, Han Chinese are more affected by the traditional Confucian ideology and hold a strong son preference than other ethnic minority groups. Besides, for most of the period, minority groups had a relatively loosened birth control policy which permitted them to have two children and increased the likelihood of having a son without sex-selective abortion of female fetuses. Even so, both Han Chinese and some ethnic groups (if not all) would turn to sex-selective abortion.

There is still an interprovincial difference in SRB, though the SRB in most provinces declined markedly. Grouped by the original birth control policy of the one-child policy, 1.5-child policy and two-child policy, SRB in 1.5-child policy provinces was much higher than that in other provinces.²⁷ Even though the universal two-child policy later replaced the original locally categorised policy, the SRB in the original 1.5-child policy was still higher than that in original one-child and two-child policy provinces.

For four decades, China's SRB has exceeded the normal level. The past two decades first witnessed the SRB hovering at a high level followed by a decline in the last decade. As the overall SRB has declined markedly from the historical peak and approaches the normal level, the once hot-debated topic drew less attention. However, the effect of skewed SRB over four decades is far reaching. Moreover, even with the universal two-child policy, the SRB is still beyond the normal level. The deeply entrenched son preference, though waning, is not

exterminated yet. China should take further measures to combat the high SRB, tackle its negative consequences to create a harmonious society.

Contributors Both authors contribute equally to this paper.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon request.

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