Sex-selective Abortions Over the Past Four Decades in China

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Abstract

Background: China now faces multiple challenging demographic and public policy problems that have emerged from four decades of sex-selective induced abortions. The sex-selective induced abortion of female fetuses has been under-examined quantitatively in China.

Methods: Using annual data on the officially registered number of births, induced abortions, and SRB data, we estimate the annual number of sex-selective abortions and then estimated two related proportions over the past decades.

Results: The annual proportions and number of selective abortions rose in the 1980s with the strict family planning policy and the diffusion of sex identification technology, remained at a high level between 1990 and 2010, and then declined, totaling 29.70 million. The abortion of second-order female fetuses was the largest proportion of all sex-selective abortions but declined after 2000 partly due to the change in birth composition by order. Children's composition affected sex-selective practice. Village selective abortions accounted for the majority of all selective abortions but decreased markedly in 2010 with changes in birth composition by residence. The rural-urban comparison by order indicated that urban couples were not less likely to abort female fetuses than their rural counterparts. Sex-selective abortions still exhibit provincial differences.

Conclusions: In China, due to the long-standing preference for sons, easy access to sex-selective technologies, and the spontaneous fertility decline, the practice of selectively aborting female fetuses would have existed for a long time despite China has outlawed such practices, and the imbalanced sex structure may take many years to normalize.

Introduction

Induced abortion has been a great concern in China. According to the official statistics, the annual number of registered induced abortions increased from 5 million in the early 1970s to a peak of 14.37 million in 1983, then fluctuated between 10 and 14 million for a decade. Since 1993, the annual number has fallen below 10 million and was 9.63 million in 2017, 9.76 million in 2019 (National Health Commission, 2020). Induced abortions fall into three categories in China, namely voluntary induced abortions, involuntary induced abortion as a submission to the family planning policy, and sex-selective induced abortions which are interwoven with the first two categories. For voluntary induced abortion, China legalized induced abortions to satisfy the demand for voluntary control over excess births as early as in the 1950s (Luk, 1977; Rigdon, 1996; Liang, 2014). After 2000, small-scale surveys concerning young women indicate that young women under 25 years old and unmarried women accounted increasingly for induced abortions (Wu and Qiu, 2010). For involuntary induced abortion, has been mainly linked to and complicated by China's birth control policy over the past decades (Nie, 2005). Ever since the early 1980s, forced abortions have been prevalent in the implementation of the birth control policy to help family planning cadres to achieve their quotas, and compliance with the family planning was a prominent reason for induced abortions (Rigdon, 1996; White, 2006; Y. Li, 2012). In many official provincial family planning regulations, induced abortion was introduced as a remedial measure for out-of-quota pregnancies following the guidelines of the national decree (Basten and Jiang, 2014). However, with the currently available data, it is difficult to estimate the number of involuntary abortions.

Sex-selective induced abortion has been reported since the early 1980s with the strict implementation of the one-child-per-couple policy and the availability of sex identification technology (Hull, 1990; Zeng et al., 1993; Rigdon, 1996). The decline in fertility, either spontaneously due to socioeconomic development or involuntarily due to compliance with the family planning policy, increased the pressure for sex selection in the context of son preference

(Guilmoto, 2009; Dubuc and Sivia, 2018). The introduction of ultrasound B machines and the availability of sex identification technology made the abortion of female fetuses widespread in China. Since sex-selective abortion has been prohibited, the extent to which sex-selective induced abortions are practiced is subject to debate, and the actual number of selective abortions is impossible to obtain, it can only be estimated (Hesketh et al., 2005; Chen and Zhang, 2019). An estimate made three decades ago claims that, even if the abortion of female fetuses could explain the entire distortion in China's SRB, it would account for less than 5 percent of all abortions reported for 1986 (Hull, 1990). Another survey of 820 women conducted in central rural China in 2000 found that 36 percent of reported 301 induced abortions were female sex-selective abortions (Chu, 2001). Selective abortion could change with the introduction of prenatal care technology that can predict fetal sex with far greater certainty (Rigdon, 1996).

To date, studies have majorly focused on a quantitative discourse on SRBs, and adopted SRB as an indicator of sex selection (Goodkind, 1996; Hesketh et al., 2005; Jha et al., 2011). However, sex-selective abortion itself has been under-examined from a quantitative perspective, except for being recognized as one contributor to high SRBs. In this paper, we used annual data on the officially registered number of births, induced abortions, and SRB to estimate the annual number of sex-selective abortions, and then estimated two related proportions over the past decades. For certain years with data, we elucidate the difference by birth order, residence, and province. Below we first introduce the method, and then we introduce the data. After this, we present the results, and then conclusions.

Method

As the number of sex-selective induced abortions has to be estimated (Hesketh et al., 2005; Chen and Zhang, 2019), we use annual numbers of births, abortions, and SRBs to compute the number of sex-selective abortions by comparing the observed number of female births with the referenced or expected figure.

Let N_a represent the number of induced abortions, N_{ssa} denote the number of sex-selective induced abortions, stand for the number of births, B_m and B_f the number of male and female births. SRB_o denotes the observed SRB , and SRB_n the normal SRB without selective abortions. China's normal SRB is generally assumed to be 106 male births for every 100 female births (Coale and Banister, 1994), therefore we adopt SRB_n as 106. It is generally assumed that male fetuses are not selectively aborted and the number of male births can be taken as a benchmark (Coale and Banister, 1994; Bongaarts and Guilmoto, 2015; Chao et al., 2019). We calculate the number of sex-selective induced abortions of female fetuses as:

$$N_{ssa} = \frac{B_m}{SRB_n} \times 100 - B_f$$

1

With the estimated number of sex-selective induced abortions, we can calculate the proportion of sex-selective induced abortions to the total induced abortions. China registered induced abortions and other family planning surgical operations annually (NHFPC, 2020). If we assume that spontaneous abortions and stillbirths were naturally conceived and gender-neutral, and sex-selective abortions N_{ssa} are included in the total number of induced abortions N_a , then the proportion is

$$P_{ssa/a} = \frac{N_{ssa}}{N_a} \times 100\%$$

2

Still, we can calculate the proportion of sex-selective induced abortions to the expected number of female births computed as the sum of female births and sex-selective induced abortions expressed in Formula (3).

$$P_{ssa / (ssa + B_f)} = \frac{N_{ssa}}{(N_{ssa} + B_f)} \times 100\%$$

3

The above expressions can still be computed by birth order, residence, and province.

Data

The data used include annual birth numbers, induced abortion numbers, and SRBs. The annual birth numbers can be obtained from several government departments such as the Ministry of Public Security for household registration, the National Family Planning Commission for monitoring births in family planning implementation, and the National Bureau of Statistics (NBS) as the authoritative organization of population statistics.

Underreporting has been a concern in China's birth data quality (Goodkind, 2011). China's NBS was aware of the issue of underreporting in censuses, intercensal 1% population sample surveys, and annual one-per-thousand sample surveys, so the NBS adjusted upward the fertility levels (Zhang and Zhao, 2006; Goodkind, 2011). The registered total fertility rate (TFR) in the 2000 census is 1.22, but the fertility rate internally used by the NBS is 1.40 (Morgan et al., 2009), indicating an official acknowledgment of a severe under-enumeration of births in census data. The crude birth rate (CBR) derived directly from 2000 and 2010 census data were 9.85‰ and 9.43‰ respectively, but the officially announced CBR for 2000 and 2010 were 14.03‰ and 11.90‰, respectively, as available in the official yearbooks. A new consensus argued that the NBS over-adjusted the fertility levels (Zhang and Zhao, 2006; Morgan et al., 2009; Goodkind, 2011).

In addition to underreporting in births, there is a sex-selective underreporting of female births and a controversial level of SRB. Sex-selective underreporting of female births is regarded as a determinant in China's distortion in SRB (Hull, 1990; Zeng et al., 1993; Chu, 2001; Goodkind, 2011; Chen et al., 2015). While most studies argue that female births have been predominantly under-enumerated and that the actual SRB should be lower than observed, some others believe that it is male births that are rather underreported. There are also claims that female under-reporting accounts for a very small portion of China's higher SRB, and the majority of SRB distortion is attributed to sex-selective abortion of female fetuses (Coale and Banister, 1994; Zhu et al., 2009).

The accuracy of the number of induced abortions is also a subject of debate. China registers induced abortions (NHFPC, 2020), and some demographers argue that the official figures are a reasonably accurate representation of total induced abortions (Rigdon, 1996). However, there were portions of induced abortions not registered in the official system (Tu and Smith, 1995), partly due to the social unacceptability of extramarital pregnancies in China (Banister, 1987) and the illegalization and prohibition of non-medical sex-selective abortions (Rigdon, 1996; Chen and Zhang, 2019). Recently young and unmarried women accounted for an increasing portion of abortions (Wu and Qiu, 2010). While small-scale surveys indicated under-enumeration in abortions and sex-selective abortion numbers (Chu, 2001; Nie, 2011), the extent of under-reporting was not officially or reliably provided.

In this paper, we mainly used the official data. For annual births, the NBS published annual year-end population size and crude birth rates. With these, we calculated annual births from 1980 to 2019, which are consistent with the data published in the annual statistics communique available from 1997 to 2019. As calculated births cannot be divided

by sex, we used the SRB from census data or annual sample surveys to divide them into male and female births. In census years or intercensal 1% population sample survey years, information on birth order and residence (urban or rural) was also provided, so we obtained birth numbers by birth order and residence for those years.

For SRB data, in census years or intercensal 1% population sample survey years, the number of male and female births by birth order, residence, and province were provided, so with these data, we could calculate the SRB. For other years after 1986, the SRB was calculated based on the annual one-per-thousand sample survey. For years before 1986, the SRB data were cited from the tabulated results from China's 1988 National Fertility Survey (the two per thousand survey), a representative survey with an emphasis on the birth history of 459000 married women of 15–57 years old in 1988 (Liang and Chen, 1993). One concern is the comparability and consistency of SRB over time due to the marked variation in sample size from over 10 or 20 million in census years to just more than 10 thousand births in one-per-thousand sample surveys. In most years, the SRB was calculated based on a one-per-thousand sample, and the smallest sample size exceeds 10 thousand births, which attenuated the concern of comparability.

For induced abortion data, we adopted annual induced abortion numbers from the yearbooks published by China's Ministry of Health (renamed Public Health and Family Planning Commission in 2013 and Health Commission in 2018). This organization registered family planning surgical operations including induced abortions that could be tracked in hospitals, clinics, and family planning service stations. But whether induced abortions without official registration were estimated and included in the official figures or not was clear. In one authoritative book titled "Chinese Obstetrics and Gynecology" published in 2006 (Cao, 2006), the author said the number for recent years was 13 million, without stating any reference. According to the publication year and the numbers in official yearbooks, there could be 40 to 50 percent underreporting. Pending the availability of a more reliable data source, we used the above data for now. Below we have a subsection for the discussion of the resulting quality.

Results

SRB trend

FIGURE 1 depicts China's overall SRB from 1980 to 2019 and SRBs by birth order in 1982, 1987, 1990, 2000, 2005, 2010, and 2015. FIGURE 2 presents SRBs by residence in 1987, 1990, 2000, 2005, 2010, and 2015. The trend of China's SRB and the difference in SRB by birth order and residence have been well documented, so we do not reiterate here.

Induced abortions

Table 1 presents the number of induced abortions. Induced abortion varied over the period from 1980 to 2019. Already in the 1970s, birth-control operations were prevalent in association with the campaign to enforce birth limits (White, 2006; Whyte et al., 2015). The rise in the incidence of abortions was particularly notable in 1979–1980 as the Chinese government began the strict one-child-per-couple policy (Tien, 1987; White, 2006; Whyte et al., 2015). Induced abortion has played a significant role in China's attempt to control its population growth, and has been officially advocated as a "remedial" measurement for out-of-quota pregnancies and the most effective way to achieve the family planning goals set by the governments. Induced abortion was adopted by local authorities to meet their preset demographic target, and by families to avoid penalties for an unplanned birth (Tu and Smith, 1995). The number of abortions was 7.86 million and 9.53 million in 1979 and 1980 respectively, compared to 5.39 million in 1978. It increased steeply further to 12.42 million in 1982 with the tightening up of birth control implementation. In 1983, the number reached a peak of 14.37 million when the government launched a drive to

promote its one-child policy. Qian Xinzong, the new director of State Family Planning Commission, launched a mass sterilization campaign nationwide. It involved enforcement measures like dismantling houses and confiscation of stored grain and livestock of family planning policy violators. Also were measures of strict performance evaluation on family planning cadres (White, 2006; Liang, 2014; Chen, 2015). By combined measures of reward, persuasion, and coercion, this mass sterilization campaign in 1983 numbered 58.21 million family planning surgical operations in total, including 14.37 abortions (White, 2006; Liang, 2014). However, the enforced measures and campaigns caused an uproar and ignited strong resistance, the central government was not satisfied either (Liang, 2014; Chen, 2015). In 1984, with the dismissal of Qian Xinzong from his office and the issuance of Central Document 7 to relax the stringent birth control policy (Hardee-Cleaveland and Banister, 1988; White, 2006; Liang, 2014), the number of induced abortions dropped steeply in 1984.

In the late 1980s and early 1990s, the number rebounded when the government imposed measures to minimize the unfavorable demographic impact of the relaxed policy introduced in 1984, and again strengthened its mandatory program on induced abortion and sterilization (Hardee-Cleaveland and Banister, 1988; Wang, 2014). Afterward, the number of induced abortions began to decline. On one hand, following the 1994 International Conference on Population and Development held in Cairo, the Chinese government promoted the client-centered and informed-choice contraceptive policy in family planning implementation (Wang, 2014). Mandatory induced abortions gave way to contraception and social maintenance fee policy for out-of-quota births. On the other hand, China's fertility level continued to drop, out of quota pregnancies had been markedly reduced with the spontaneous or involuntary decline in fertility level. The significance of induced abortions in birth control policy has decreased gradually, even though it was still the officially approved and advocated remedial method for out-of-quota pregnancies (Y. Li, 2012; Basten and Jiang, 2014). During this period, a large proportion of induced abortions was involuntarily performed (Whyte et al., 2015; Wang et al., 2016).

Since the middle 1990s, the number of induced abortions has been quite stable, but recently it resurged. Along with the involuntary induced abortions required by the birth control policy is voluntary induced abortions, which took more and more weight in total induced abortions with the spontaneous decline in fertility. As early as in the 1950s after the founding of the People's Republic of China, women appealed for less restricted access to contraception and abortion, and the government responded positively to this appeal (Liang, 2014). But due to the significance of involuntary induced abortions related to the family planning policy, voluntary induced abortion was neglected over decades. For some empirical research on induced abortions, China's family planning policy was regarded as a dominant predictor for abortion (Wang, 2014). From 2009 to 2019, while the total number of family planning operations decreased from 22.77 million to 16.40 million, the percentage of induced abortions increased from 6.11 million and 26.8 percent to 9.76 million and 59.54 percent. On one hand, the conception rate of married childbearing women dropped from around 89.0 percent in 2009 to 80.6 percent in 2018 (National Health Commission, 2019), which increased the likelihood of unwanted pregnancies and induced abortions. On the other hand, unmarried young women, especially those rural-urban migrant females accounted increasingly for induced abortions (Wu and Qiu, 2010). Globally 27 percent of induced abortions were obtained by unmarried women in 2010–2014 (Sedgh et al., 2016), women in the 20–24 age group tend to have the highest abortion rate, and the bulk of abortions are accounted for by women in their twenties (Singh et al., 2018). China has been more and more tolerant of extramarital pregnancy and induced abortions, coinciding with the global trend. Worldwide, an estimated 50.4 million induced abortions occurred annually in 1990–94, and 56.3 million in 2010–2014 (Sedgh et al., 2016). China accounted for a marked proportion of the world total.

Table 1
Number and proportion of sex-selective abortions

Year	SRB	No. of Birth(million)	Na(million)	Nssa(thousand)	Pssa/a(%)	Pssa/(bf + ssa)(%)
1980	107.4	17.87	9.53	113.80	1.19	1.30
1981	107.1	20.78	8.70	104.12	1.20	1.03
1982	107.63	22.47	12.42	166.42	1.34	1.51
1983	107.9	20.66	14.37	178.12	1.24	1.76
1984	108.5	20.63	8.89	233.36	2.62	2.30
1985	111.4	22.11	10.93	532.81	4.87	4.85
1986	112.3	23.96	11.58	670.77	5.79	5.61
1987	109.6	25.29	10.49	409.78	3.91	3.28
1988	108.1	24.64	12.68	234.58	1.85	1.94
1989	112.54	24.14	10.38	700.76	6.75	5.81
1990	111.45	23.91	13.49	581.16	4.31	4.89
1991	118.33	22.65	14.09	1206.36	8.56	10.42
1992	115.94	21.25	10.42	922.65	8.86	8.57
1993	115.11	21.32	9.50	851.98	8.97	7.92
1994	116.30	21.1	9.47	948.21	10.02	8.86
1995	116.57	20.63	7.48	949.94	12.71	9.07
1996	116.16	20.67	8.83	916.69	10.38	8.75
1997	117.04	20.38	6.59	978.36	14.85	9.44
1998	117.03	19.91	7.38	954.45	12.93	9.42
1999	119.35	19.09	6.76	1096.09	16.20	11.19
2000	119.92	17.71	6.66	1057.57	15.88	11.61
2001	115.65	17.02	6.28	718.28	11.43	8.34
2002	119.86	16.47	6.81	979.24	14.37	11.56
2003	117.54	15.99	7.22	799.90	11.09	9.81
2004	121.20	15.93	7.14	1032.72	14.46	12.54
2005	120.49	16.17	7.11	1002.81	14.11	12.03
2006	119.58	15.84	7.31	924.20	12.65	11.36
2007	121.48	15.94	7.63	1050.74	13.77	12.74
2008	125.35	16.08	9.17	1302.58	14.20	15.44
2009	124.16	16.15	6.11	1234.33	20.20	14.63

Year	SRB	No. of Birth(million)	Na(million)	Nssa(thousand)	Pssa/a(%)	Pssa/(bf + ssa)(%)
2010	121.21	15.92	6.36	1032.42	16.23	12.55
2011	114.66	16.04	6.63	610.26	9.20	7.55
2012	118.88	16.35	6.69	907.66	13.57	10.83
2013	117.64	16.4	6.24	827.72	13.27	9.90
2014	113.98	16.87	9.62	593.73	6.17	7.00
2015	112.55	16.55	9.85	480.96	4.88	5.82
2016	116.23	17.86	9.64	797.26	8.27	8.80
2017	113.31	17.23	9.63	557.34	5.79	6.45
2018	113.88	15.23	9.74	529.66	5.44	6.92
2019	113.93	14.65	9.76	512.31	5.25	6.96

Number and proportion of sex-selective induced abortions

Table 1 and FIGURE 3 present the number and proportions of sex-selective induced abortions.

The number and proportion of sex-selective induced abortions changed over time. There were three methods for sex identification, namely chorionic biopsy, amniocentesis, and ultrasound examination (Hull, 1990). Before 1979 when China manufactured its first ultrasound B machine, there was no readily available sex identification technology, as can be proved by the constancy of normal SRB before the 1980s (Coale and Banister, 1994; Cai, 2009). Since the early 1980s, China began to introduce ultrasound B machines on a large scale, and put imported and locally made ultrasound B machines into use (Zeng et al., 1993; Coale and Banister, 1994). Ultrasound B machines were quickly exploited as a means to determine gender for sex-selective abortions (Goodkind, 1996).

In the early 1980s, the number and proportion of sex-selective abortions began to rise. As ultrasound technology was first introduced in the early 1980s, some western scholars doubted the availability of this technology and its wide access in the 1980s in China and thought sex-selective abortions were trivial if not nonexistent (Aird, 1990; Johansson and Nygren, 1991). Most scholars believed that ultrasound technology was applied to sex selection, especially in the middle 1980s and later (Hull, 1990; Zeng et al., 1993; Coale and Banister, 1994). Due to the uncertainty in the extent of the availability of the technology, and the government's concerns over its illegal application for sex selection, it was difficult to gauge the prevalence of sex-selective abortions (Hull, 1990). Zeng et al. (1993) argued that the illegal use of this technology for sex identification was not rare. Our estimates showed that in 1980 through 1984 sex-selective induced abortions were just incipiently spreading. First, the ultrasound B machines and sex identification technology were just introduced and not widely available to the public, since technical diffusion took time for the public to adopt. Second, stringent one-child birth control was implemented with nationwide mass sterilization campaigns, depriving people of chances for repeated pregnancies.

The number and proportions were relatively high after 1984. In 1985, the number jumped to half a million and the two proportions to almost 5 percent. One reason is the diffusion of sex identification technology and the increasing availability of ultrasound B machines. In 1987, over 13000 ultrasound B machines were used in China, six for each county on average (Chu, 2001). Zeng et al. (1993) said only in 1989 were 2175 high-quality color ultrasound B

machines imported to China as more were imported in 1985. Besides, around 1990 China could produce over 10,000 such devices per year, and clinics and family planning service stations in most townships had such equipment (Zeng et al., 1993; Chu, 2001). Another reason is the partial relaxation of the draconic one-child policy due to strong opposition with the issuance of Central Document 7 in 1984 and the Central Document 13 in 1986 (Bongaarts and Greenhalgh, 1985; Gu et al., 2007; Liang, 2014; Chen, 2015). With this relaxation, rural couples in some provinces were permitted a second child and had the chance for repeated pregnancies and sex-selective induced abortions. Medical records of over 1.24 million pregnancies, presumably free of sex-selective underreporting, indicated that the SRB from 1988 through 1991 was 108.0, 108.3, 109.1, and 109.7. This evidence meant that some of those women had undergone sex-selective abortion before this pregnancy, and also proved the increasing prevalence of ultrasound B technology and sex-selective induced abortions in the late 1980s (Zeng et al., 1993; Coale and Banister, 1994). Around 1990, the sex ratio of 500 rural induced abortions and 1,226 urban abortions was 94.6 and 96.8 males for 100 females (Zeng et al., 1993), lower than the natural SRB of 106 male births for 100 female births. Hull (1990) estimated that the number of sex-selective induced abortions would represent less than 5 percent of all induced abortions reported for 1986. Our estimate shows that in the middle and late 1980s the number of sex-selective abortions fluctuated around half a million and the proportions to total abortions and the expected births around 5 percent.

For the two decades from 1990 to 2010, both the number and the proportions fluctuated at a very high level, oscillating around 1 million and stabilizing above 10 percent for most years. This high level could be ascribed to several factors. The first factor is further diffusion of sex-selection technology and readily accessible equipment. By 2000, almost all hospitals and family planning service stations at and above the township level were equipped with high-quality ultrasound B machines with skilled technicians (Chu, 2001). Many private clinics and individuals also had such machines and provided sex identification services to individuals, even poor mountainous villagers turned to ultrasound B machines for sex determination (Hardee-Cleaveland et al., 2000; Chu, 2001). Over one-third of ultrasound B-scans were performed in private clinics, intentionally for the information on the sex of the fetus (Chu, 2001). Sex-selective induced abortions were so widespread and readily accessible that Article 35 of The Population and Family Planning Law of PRC approved taking effect in 2002 states that: it strictly prohibits non-medical sex identification of fetuses via ultrasound B machines and other technologies, it strictly prohibits non-medical sex-selective termination of pregnancies, namely illegal fetal sex identification and illegal sex-selective induced abortion, generally referred to as “two illegals”. There were frequent ad-hoc crackdowns on and routine inspections of “two illegals” by family planning commissions at all levels (Li, 2007; Murphy, 2014). The second factor is the birth control implementation characterized by a predominant 1.5-child policy in most rural regions. Following the 1983 mass sterilization campaign, the central government relaxed the one-child policy and offered rural couples having a girl a second birth under certain conditions in some provinces (Greenhalgh, 1986; White, 2006; Gu et al., 2007; Liang, 2014). By 1990, almost 20 provinces implemented the 1.5 child policy in rural areas (Zeng, 1989; White, 2006; Gu et al., 2007; Liang, 2014). This policy devalued daughters, and implicitly stimulated couples to abort female fetuses (Zeng, 2007; Murphy, 2014). The third reason is the fertility squeeze effect, namely the role of the declining fertility in exerting pressure on couples to resort to sex-selective abortion (Li et al., 2000; Guilamoto, 2009; Bongaarts, 2013; Dubuc and Sivia, 2018). China observed a decline in fertility from above the replacement level in the 1980s to around 1.5 or even lower in terms of TFR in the 1990s and later (Goodkind, 2011). Fertility decline and small family norm increase the likelihood of remaining sonless, place more couples in the sex-selection situation, and increase the likelihood for couples to undertake sex selection, usually at second or higher order. The experience in South Korea in the 1980s and early 1990s indicates that the swift diffusion of ultrasound, alongside the normalization of the small family norm, resulted in more prenatal sex selection (Kashyap and Villavicencio, 2016). According to a survey in

central rural China conducted in 2000, among 427 male and 279 female fetuses, 25.4 percent of the female fetuses were aborted, compared to just 1.6 percent of the male fetuses (Chu, 2001). An estimate of 19.1 percent of couples in 1.5-child policy areas underwent sex-selective abortions, compared to only 4.6 percent in two-child policy areas (Zeng, 2007). In 2007, the National Population and Family Planning Commission conducted a survey of aborted fetuses in some provinces over seven years from 2000 to 2006. The survey was carried out by provincial and local family planning organizations. The number of fetuses identifiable by sex in 2000 to 2006 was 12677, 10922, 12301, 13742, 14937, 15541, 18549 respectively, and the ratio of males for every 100 aborted female fetuses was 74.02, 70.47, 73.45, 72.51, 71.79, 71.31, 64.89 respectively. About a third of the aborted female fetuses were selectively aborted (Cai, 2009).

Ever since 2010, the number dropped below 1 million and proportions below 10 percent. The prenatal sex identification technology has been easily available and affordable, and fertility remained at a very low level spontaneously, both of which contributed to sex-selective induced abortions. There are still other factors pushing the sex-selective abortion phenomenon down. China continuously advocates gender equality and the social status of women has improved markedly, while China combats “two illegals” (Li, 2007; Murphy, 2014). In 2014, Hubei province alone rewarded more than 540 people who reported “two illegals” cases, broke 4193 “two illegals” cases, and punished 422 doctors who practiced “two illegals” (Z. Jiang et al., 2015). After decades of sex-selective induced abortions and imbalanced sex structure, China is confronted with a severe shortage of marriageable women and an oversupply of marriageable men. In such a context, parents especially rural parents have to accumulate enough wealth for getting their son married. The rising bride price and marriage expenses usually deplete parents of their lifelong savings and frequently get them into debt (Jiang et al., 2015). Some scholars argue controversially that women in short supply may benefit in conjugal and reproductive function and enjoy a better social status (Park and Cho, 1995). Surveys in rural China did indicate a markedly improved bargaining power of women over marriage and intra-household power structure, as well as a radical change in attitude towards sons and daughters (Z. Li, 2012). China may optimistically follow the SRB transition trajectory of South Korea and return to normal (Das Gupta et al., 2009; Guil moto, 2009), which means that there would be no more sex-selective induced abortions.

The number and proportions of sex-selective induced abortions to total abortions and expected births began to rise in the 1980s, remained at a high level in 1990 through 2010, and then declined. The sex-selective induced abortion of female fetuses accounted astonishingly for 15.88 percent and 16.23 percent of all induced abortions indicated in 2000 and 2010 respectively and accounted surprisingly for 11.61 percent and 12.55 percent of expected female births indicated in 2000 and 2010 respectively. There has been a total of 29.70 million sex-selective aborted female fetuses.

Number and proportion by birth order

We still examined the number and proportion of sex-selective induced abortions by birth order, as presented in FIGURE 4. Whether the female fetus will be aborted or born after an ultrasound B-scan is related to the order of the pregnancy and children composition. The higher the pregnancy order, the more likely the female fetus is to be aborted (Chu, 2001).

For first births, the number and proportion were negligible before 2010 but rose in 2010. Since the late 2000s, as fertility spontaneously declined further, people turned to sex-selective abortion for first births. The survey data collected in 2013 in western China indicate that couples with son preference would turn to sex-selective induced abortions to ensure a son at first birth, and then subdue their intention to produce a second child (Jiang et al., 2016).

For second, third and above births, the number and proportion rose in the 1980s, remained at a high level during most of the period, and declined after 2010. Scholars have discerned the sex-selective induced abortion contribution to the distortion in China's sex ratio at the second birth order in the 1980s (Coale and Banister, 1994). In 2005, the intercensal 1% population sample survey indicates that the sex ratio rose steeply for second-order births while for first-order births it's normal (Zhu et al., 2009). According to our estimate, the abortion of second-order female fetuses contributed most to the total of sex-selective induced abortions, followed by third-order induced abortions. In 2000, the sex-selective induced abortions at second-order births accounted for 75.08 percent of all sex-selective induced abortions, whereas the sex-selective induced abortions at first-order births accounted for about 5.8 percent. In 2010, the percentage of first-order selective abortions rose to 32.70 percent due to the increase in the selective induced abortions at first birth as a result of fertility decline and to the change in birth order composition. For the proportion of sex-selective induced abortions to the expected female births by birth order, the proportion of selective abortions to the expected births at first order is relatively low, and the proportion at second- and third-order is much higher, indicating the prevalence of selective abortion for higher birth orders.

Besides birth order, the heightened tendency of being aborted for female fetuses is correlated with the children's composition. Couples with only daughters are more likely to sex-select their next fetus to ensure a son. The 1990 census data indicate that the sex ratio of second births for women who had a daughter was 149.44, and 224.88 for women with only two daughters (Li, 1992; Das Gupta, 2006). In 2000, the survey conducted in central rural China with a 1.5 child policy as mentioned above showed that 92 percent of the female fetuses in the second pregnancy were aborted if the first child was a girl, versus 5 percent if the first child was a boy (Chu, 2001). In the official survey implemented in 2007 in Cai (2009), among the aborted fetuses identifiable with gender, families with only one daughter recorded the lowest sex ratio of 50.18, and 70.06 for families with only two daughters (Cai, 2009).

We calculate the proportion of sex-selective induced abortions by children composition in 1990 and 2000. The data for the 1990 calculation is 1 percent of the total population from the Integrated Public Use Micro-data Series (<https://ipums.org/>), including 3.21 million 15-49-year-old women with birth information. For 2000, we had no micro-data and adopted the SRB data from Sun (2005). The proportion of sex-selective induced abortions to the expected births by birth composition is listed in Table 2. The results reveal that the heightened tendency of being selectively aborted for female fetuses is closely related to the sex composition.

Table 2
Proportion of sex-selective induced abortions by children composition

Children composition		Proportion % (No. of female births)	
Boys	Girls	1990	2000
0	0	-0.14(59,338)	-0.47
1	0	-5.31(17,377)	1.21
0	1	26.53(15,096)	44.21
2	0	-38.10(3,218)	-38.56
1	1	7.67(5,513)	13.19
0	2	48.64(3,360)	72.15
3	0	-51.76(461)	
2	1	-17.62(1,063)	
1	2	25.54(1,480)	
0	3	48.70(903)	
Data source: Data for 1990 was calculated by author with data from the IPUMS. Data for 2000 was calculated with SRB from Sun (2005).			

Number and proportion by residence

FIGURE 5 presents the number and proportion for city, township and village populations. In 1987 and 1990 the proportion of selective induced abortions to the expected births was very low but rose steeply in 2000. Village and township proportions were higher than that of the city. In the countryside, sons could provide labors in the agricultural production, continue the family lineage, and provide old-age support for parents, therefore sons were much valued among the rural population. Rural couples in the 1.5 child policy areas preferred to have one daughter first so they could have a second birth for a son to achieve “having both a son and a daughter” in compliance with the policy, but that also meant much pressure to ensure a son and higher likelihood of resorting to sex-selective induced abortions at second birth.

The majority of sex-selective induced abortions of female fetuses took place among rural couples. In 2000, the number of sex-selective induced abortions for the city, township, and village populations was 125 thousand, 138 thousand, and 795 thousand, accounting respectively for 11.79 percent, 13.08 percent, and 75.14 percent of all sex-selective induced abortions. The number for village population declined to 594 thousand, and the proportion declined to 57.57 percent in 2010. In contrast, city and township selective induced abortions increased rapidly to 21.75 percent and 20.68 percent of total selective induced abortions respectively due partly to the rapid urbanization process from 36.92 percent in 2000 to 50.27 in 2010.

It was generally argued that rural parents were more likely to sex select children. Sex selection mostly occurred among the rural population. However, when we broke down the proportion of selective abortions to the expected births by birth order for city, township, and village populations, as shown in Table 3, we found that the proportion for city and township populations were not significantly lower than the corresponding proportion for village population, indicating that urban people were not less likely to sex select their children than their rural counterparts for the same

birth order. But as first births with a much lower percentage of selective abortions accounted for 87.14 percent and 80.08 percent of all city births and township births respectively in 2000, and 78.28 percent and 64.04 percent in 2010, much higher than the 66.22 percent in 2000 and 57.58 percent in 2010 for village population, the overall percentage of selective abortions to expected births ranked highest among village population than the urban population.

Table 3
Proportion of selective abortion by birth order and residence (%)

Birth Order	2000	2010				
	City	Township	Village	City	Township	Village
1	2.64(94324)	3.95(56390)	-0.33(237653)	6.56(112956)	7.41(64641)	6.71(168579)
2	28.19(12456)	31.43(12042)	30.33(97865)	19.81(28618)	20.21(31639)	17.80(101409)
3+	37.33(1458)	41.23(1985)	32.47(23355)	39.55(2722)	37.27(4660)	31.27(22763)
Total	7.14(108238)	11.59(70417)	12.88(358874)	10.42(144296)	13.65(100940)	13.18(292751)
Note: number in the parenthesis is the number of female births.						

Number and proportion by province

FIGURES 6–8 present the number and proportion of sex-selective induced abortions by province. FIGURE 6 presents the temporal trend of each province and the comparison among provinces in terms of the proportion of sex-selective induced abortions to the expected births. Generally, the proportion rose from 1990 to 2000 and 2010, then declined in 2015, with a marked provincial difference. FIGURES 7 and 8 illustrate the spatial discrepancies with maps. The central and eastern provinces have a higher proportion and larger numbers due to their larger population and the fertility squeeze.

China is characterized by a vast provincial difference in population indicators like population size, number, and order composition of births. According to the 2000 and 2010 censuses, nine provinces had a population of over 50 million, while five and four provinces had a population of less than 10 million in 2000 and 2010 respectively (PCO 2002, 2012). Along with the marked difference in population indicators was China's provincially localized family planning policy (Zeng, 1989; White, 2006; Gu et al., 2007; Liang, 2014). Around 2000, six provinces implemented one-child policy, including Beijing, Tianjin, Shanghai, Chongqing, Jiangsu, and Sichuan; five provinces implemented two-child policy, including Hainan, Ningxia, Qinghai, Yunnan, and Xinjiang; and the other 19 provinces implemented 1.5-child policy (Gu et al., 2007). Each province has its policy fertility circa 2000 and 2010 (Gu et al., 2007; Yin et al., 2013). In provinces granting a quota of 1.5 or two births per couple, couples relied heavily on selective induced abortion for the second pregnancy if their first-born was a daughter (Ebenstein, 2010). The SRB in one-child policy areas was 111.6, lower than the SRB of 124.7 in 1.5-child areas but higher than that in two-child areas (Zeng, 2007). The difference in selective abortions by province is a combined result of socioeconomic development, cultural environment, population base, family planning policy as well as many other factors. Due to space limitations, we do not investigate further into provincial differences.

Conclusion

Sex-selective induced abortion of female fetuses has been practiced since the early 1980s in China, and will still be performed widely in the future. The spread of sex-selective induced abortion has been facilitated by China's family planning program that adopted abortion as one remedial measure for out-of-quota pregnancies. This phenomenon, first as a countermeasure by farmers against the birth constraints, is now an active measure by couples with son preference in the fertility squeeze context. Due to legal, ethical, and moral considerations, the data on sex-selective induced abortions is unavailable. In this paper, with official data we estimated the number and proportions of sex-selective induced abortions of female fetuses, the findings are as follows.

The annual proportions and number of sex-selective induced abortions of female fetuses began to rise in the 1980s, remained at a high level in 1990 through 2010, then declined. This practice of selective abortion was made instrumentally possible by the large-scale introduction of ultrasound B machines in the early 1980s but was driven mainly by the conflict between the birth constraint of the nationwide family planning and the pursuit of sons by the peasants. At the beginning stage, the proportions and number were low, but with the diffusion of this technology and the stringent implementation of family planning policy, the proportions and number remained at a high level for two decades and declined in the 2010s due to the mainstreaming of gender equality and improved status of women. Worldwide sex-selective abortions represented around 3 percent of all induced abortions (Bongaarts, 2013), China was much higher than that. More recently, with the relaxation of family planning and the spontaneous fertility, people mostly intended to have only one child or two children, selective abortion is still being practiced. There has been a total of up to 29.70 millions of sex-selective induced abortions of female fetuses between 1980 and 2019 according to this estimate. This total number is higher than that of 11.9 million (with interval confidence 8.5–15.8 million) missing female births for the period between 1970 and 2017 obtained by Chao et al. (2019), and is lower than the general claim that China is short of 30 to 40 million missing females (Nie, 2011; Bongaarts and Guilimoto, 2015) that comprise both sex-selective abortion and excess female child mortality. But this number should be interpreted with caution, as it was affected by some factors. If we took the lower bounds or upper bounds of all SRBs, the total number of selective abortions of female fetuses would be reduced to 20.41 million or increased to 36.88 million². Still, due to underreporting in total induced abortions, the proportion of selective induced to total induced births should be downward adjusted accordingly.

The proportions and number of selective abortions varied with birth order and children composition. For first births, the proportions and number were negligible before 2010, but rose in 2010, as couples with son preference tended to abort the female fetus at first order recently to have a son with just one birth. The proportions and number for second, third and higher-order births rose in the 1980s, and remained at a very high level during most of the period, then declined after 2010. With the availability of sex identification technology, a county could increase the probability of a male birth by 1.3 and 2.4 percentage points for second-order and third- or higher-order births, or even by 4.8 percentage points for second-order births and 6.8 percentage points for third-order births for couples with no sons (Chen et al., 2013). China's localized family planning policy, especially the 1.5 child policy in rural areas, stimulated couples to abort female fetuses (Zeng, 2007; Goodkind, 2011). Sex-selective abortions are most likely to occur when couples had only daughters, the more daughters there are, the more likely for the next female birth to be aborted. The higher the order, the more likely it is for women to visit private clinics for the gender information of the fetus even at a higher cost (Chu, 2001). However, with the spontaneous fertility decline, birth order composition change and the intention of aborting first-order female fetuses, the proportion of abortion of first-order fetuses to total selective abortions rose markedly, from 5.8 percent in 2000 to 32.70 percent in 2010. The increasing costs of raising children have forced parents to realize their desire for a son within the confines of fewer births (Murphy, 2014), the fertility decline increased the pressure for sex selection, and people with a strong son preference tend to selectively abort female first-order fetuses (Jiang et al., 2016).

City, township, and village populations showed a difference in proportion and number in census or intercensal 1% population survey years. The proportion of selective induced abortions to the expected births rose steeply in 2000 from a past low level, village and township proportions were much higher than that of the city. Sex-selective induced abortions majorly took place among the rural population, but the proportion of urban selective abortions rose markedly due partly to the urban-rural composition change in births as a result of the rapid urbanization process after 2000. When comparing by birth order, city and township proportion was higher than that corresponding proportion of village population, urban people were not less likely to sex select their children than their rural counterparts. Just as the research by birth order in SRB (Jha et al., 2011; Goodkind, 2011), when we discuss the selective abortion difference between urban and rural populations, it is more enlightening to provide comparison by birth order after eliminating the effect of birth order composition.

For provincial comparison, the proportion generally rose from 1990 to 2000 and 2010, then declined in 2015. Central and eastern provinces had a higher proportion and larger numbers. The marked provincial discrepancy resulted from the combined effect of demographic and socioeconomic factors, and the localized family planning policy as well.

² Due to the lack of birth numbers for 1988 in Liang and Chen (1993), the lower and upper bounds of sex selective induced abortions in 1988 was replaced by the estimated number in Table 1, as is shown in Table T1.

Discussion

After four decades of selectively aborting female fetuses, China is now confronted with numerous challenging demographic and public policy questions that have arisen from sex-selective induced abortions and the subsequent phenomenon of missing girls (Nie, 2011; Bongaarts and Guilмото, 2015), which has led to an imbalanced population sex structure and a male marriage squeeze (Guilмото, 2012), and affected China's population trajectory in the long term (Attané, 2006). Accordingly, people have adjusted their economic behavior in a context of a shortage of marriageable women, for example accumulating wealth for marriage (Wei and Zhang, 2011) and raising the bride price and marriage expenditure to compete in the marriage market (Jiang et al., 2015). The long-term practice of selective induced abortions of female fetuses has affected and will continue to affect many aspects of Chinese society, the implications of which should now be handled with caution in China.

Besides, there are some direct and indirect costs of this sex-selective practice, such as the immediate costs of sex-selective induced abortion related operations and complications, the costs of medical care for longer-term health consequences. Sex-selective induced abortion is generally stigmatized. Mothers who underwent sex-selective abortions suffer psychological pressure and health risks. More broadly, selective abortion deprives the aborted fetus of the right to life and tramples on the birth right of women.

China's birth control policy and its enforcement of induced abortions as a birth control measure have been widely criticized (White, 2006), and the imbalanced sex structure and excess males due to sex-selective induced abortions and their potential threat to society have been widely discussed. A relaxation in the one-child policy could allow more parents to have a son without resorting to sex selection (Ebenstein, 2011). With the adoption of the universal two-child policy, it is optimistically predicted that the new policy will reduce sex-selective abortions and bring about a more normal sex structure. However, the voluntary use in Korea indicated that with the son preference, the falling desired family size and the easily available sex identification technology, selective abortions of female fetuses would be very common (Park and Cho, 1995). In China, due to the long-standing preference for sons, easy access to sex-selective technologies, and the spontaneous fertility decline, the practice of selectively aborting female fetuses would exist for a long time despite China has outlawed such practices, and the imbalanced sex structure may take

many years to normalize. With high levels of development, modernization, and urbanization, son preference will decline, and the value of sons and daughters tends to equalize (Chung and Das Gupta, 2007; Bongaarts, 2013). In China, the deeply entrenched son preference is currently waning due to low fertility intention, the pressure from the tight male marriage market, the heavy burden of marriage, and the improved status of women. We hope all this will reduce sex-selective abortion and improve gender equality in China.

Declarations

Ethics approval and consent to participate

This study used secondary data from the public domain and information that can identify specific individuals was not included. Ethics approval and consent to participate are not applicable.

Consent for publication

Not applicable.

Availability of data and materials:

The datasets used for analysis and reaching the conclusions of this study are available online at the National Bureau of Statistics (<https://data.cnki.net/yearbook/Single/N2021020056>) and China's Ministry of Health (<https://data.cnki.net/yearbook/Single/N2021020144>), which offer a public, open-access database.

Competing interests

None declared.

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Authors' contributions

Quanbao Jiang conceived this paper and wrote the draft, Li Mei analyzed the data and made the figures.

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Figures

Figure 1

SRB by birth order

Figure 2

SRB by residence

Figure 3

Number and proportion of sex-selective abortions

Figure 4

Number and proportion of sex-selective abortions by birth order

Figure 5

Number and proportion of sex-selective abortions by residence

Figure 6

Proportion of selective abortions ($P_{ssa/(bf+ssa)}$) over time by province

Figure 7

Number of sex-selective abortions over time by province (thousands)

Figure 8

Proportion of sex-selective abortions over time by province (%)