MedPharmRes

Journal of University of Medicine and Pharmacy at Ho Chi Minh City
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Original article

Sex-selective abortion in Vietnam during 1999-2009: the first quantitative study at national level

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Received May 21, 2020: Revised August 24, 2020: Accepted October 21, 2020

Abstract: ***Introduction:*** The sex ratio at birth has dramatically increased since 1999 in Vietnam and stood at 112.7 boys per 100 girls in 2017. This figure alarms many female fetuses are aborted for sex-selection but the numerical evidence is unknown. To depict an accurate picture about the sex-selective abortion, we conducted a study to analyze the national data for sex-abortion in Vietnam. ***Methods:*** To estimate the number of sex-selective abortions between 1999 and 2009, the 2009 Census and 1999 Life table of Vietnam were adopted. We calculated the actual number of female and male births for ten years using the reverse survival method. Then the number of sex-selective abortions was the gap between the expected and actual numbers of female births. ***Results:*** There was 217,902 sex-selective abortions, which accounted for 11.8% of all causes of abortion in Vietnam from 1999 to 2009. The number of sex-selective abortions was nearly double from 74,179 in 1999-2004 to 143,723 in 2005-2009, even the national punishments on sex-selective abortion were launched since 2003. ***Conclusions:*** Female fetuses are more likely aborted before birth for sex-selection in Vietnam because of the son preference. In the situation of Vietnam, changing the social norm regarding female values and roles in both family and society is the key solution to end this problem.

Keywords: sex-selective abortion, reverse survival method, preference for sons.

1. INTRODUCTION

"Missing women" or "missing girls" is an important factor in gender imbalance, which has been observed in many places in the world. In 2010, there were approximately 117 million missing women, most from China and India [1]. A shortfall of women would increase early marriage for women, female prostitution, trafficking of girls and women, and domestic female violence. Girls can be missing before birth because of excess female mortality in uterus, as the consequence of sex-selective abortion (SSA) or miscarriage [1]; and after birth by reasons (1) excess female mortality in infancy, which may root from the parents' discrimination, and (2) immigration of girls, which is caused by international adoption [2]. However, most miscarriages happen during the 7 weeks of pregnancy when the sex of fetus is not identified. Thus miscarriages may not associated to sex-selection. In addition, there is no system to monitor the number of miscarriages in Vietnam. The information about miscarriage can only be found in hospitals but is highly underreported. Therefore, in this current study, we focused on the females removed from the population before birth due to SSA only.

Sex ratio at birth (SRB) is the number of male births per 100 female births. The biological standard of SRB is usually close to 105. In Vietnam, the SRB significantly increased from 104 in 2003 to 110.5 in 2009; thus raising serious concerns of female discrimination, which can cause a marriage squeeze and other social consequences [3]. Sons are

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DOI: 10.32895/UMP.MPR.5.1.1

perceived as important status symbols such as indispensable elements for the perpetuation of the family surname, guarantors of the continuing worship of the ancestors, and major support for the older people in Vietnam. In tandem with the son preference, the more availability of medical technologies for sex selection and the low fertility have been the driving force of SSA [1]. In Vietnam, abortion is legal since the 1960s and women can request for abortions until the 22nd weeks of gestation [4], however, SSA has been prohibited since 2003 [5]. Thus, the numerical evidence of SSAs is obviously unknown and cannot be directly collected from the medical reports, meanwhile it is very essential to raise public's concerns and monitor the national laws effectiveness.

Currently there are two indirect methods to estimate the number of SSAs including reverse survival method and Kulkarni's method. Both methods are under the concept that the number of SSAs equals the gap between the expected and actual number of female births, given that none of male SSAs. Kulkarni's method requires many indicators such as the mid-year population, the crude death rate, and the sex ratio birth in five-year period, which is not available consistently in some developing countries, i.e. Vietnam. In addition, many steps of calculation are needed to find out the number of SSAs, thus bias can be cumulated [6]. Meanwhile, the reverse survival is simple, and accurate [7]. Using the reverse survival, the assumption is that in a closed population, children at a specific age (for example they are (n) years old) are the survivors of the living births for that amount of years ((n) years). Therefore, the number of births occurring (n) years ago can be estimated by using life-table survivorship probabilities to "resurrect' numerically those who are no longer present among the population at (n) age. The reverse survival method has been widely used in the estimation of the total fertility rate and migration [8]. This method was first applied to estimate the number of SSAs in India in 2011 [9].

In Vietnam, there is currently a lack of knowledge on the SSAs. We decided to adopt the reverse survival method to estimate the number of SSAs in Vietnam. To the best of our knowledge, this study results shows the first numerical evidence of the discrimination against female fetuses in Vietnam, and could be applied for the next coming period.

2. MATERIALS AND METHOD

Data Sources

Using the reverse survival method, we identified the numbers of males and females in 2009 from the 2009 Vietnam Census [10]. We obtained these data in two age groups, i.e. (0 – 4) and (5 – 9) groups. In addition, we used the 1999 Vietnam life table, which was estimated by the WHO in 2001. From this table, the l_0 (the radix population), the ${}_1L_0$, the ${}_5L_1$ and the ${}_5L_5$ (the person years lived of people aged (0 – 1), (1 – 5), and (5 – 10) respectively) for male and female were collected (see the whole life table in Appendix) [11].

Methodology

The numbers of males and females aged from 0 to 9 in the 2009 Census were reversed to obtain the numbers of male and female births occurring between 1999 and 2009. This method has two assumptions, including (1) no migration of children aged (0 – 9) during 1999 to 2009, and (2) full report of males aged (0 – 9) in Census in 2009.

We estimated SSAs using three following steps.

Step 1: Calculate the survival ratios for males and females

For the first step, the survival ratios for male and female aged 0 – 4 and 5 – 9 were calculated from the Vietnam life table in 1999. To reverse the survived population in the two age groups (0 – 4) and (5 – 9), we need the values of ${}_5L_0$ and ${}_5L_5$, which are the person-years lived between birth and age 5, and between age 5 and 10 respectively. The ${}_5L_0$ and ${}_5L_5$ were obtained from an empirically-based life table of the population or a model life table which are appropriate to the study context. For example, the regional model life tables or the WHO's life table. In the life table, the value of ${}_5L_0$ is the summation of ${}_1L_0$ and ${}_5L_1$ or the difference between T_0 and T_5 (the total person-year lived since age 0 and age 5).

$$ {}_5L_{0} = {}_1L_0 + {}_5L_1 \text{ or } T_0 - T_5 $$

Then the survival ratio for any age group was calculated by the following formula:

$$ {}_nS_x = {}_nL_{x+n} / {}_nL_x $$

However, the survival ratios for young age groups including age group of (0 – 4) and (5 – 9) were calculated from the following equations [12]:

$$ S_{0\text{-}4} = {}_5L_0 / 5 \times l_0 = ({}_1L_0 + {}_5L_1) / 5 \times l_0 $$
$$ S_{5\text{-}9} = {}_5L_5 / 5 \times l_0 $$

Step 2: Calculate the numbers of males and females births during 1999-2009

Applying the survival ratios for males and females (from step 1), the actual numbers of male and female births during 1999-2009 were obtained from the following calculations:

Births born 1999-2004 = Children aged (5 – 9) in 2009/ $S_{5\text{-}9}$

Births born 2005-2009 = Children aged (0 – 4) in 2009/ $S_{0\text{-}4}$

Step 3: Calculate the expected number of female births and the number of SSAs during 1999-2009

The expected number of female births was the number of male births divided by the normal sex ratio at birth. We select 105 as the normal sex ratio at birth like other studies [1, 3, 6, 9]. Then, the number of SSAs was the gap between the expected and the actual female births.

Expected female births = Actual male births *100/ 105

SSAs = Expected number of female births – Actual number of female births

3. RESULTS

The survival ratios of females and males aged less than 9

The probability of survival of females aged (0 – 4) and aged (5 – 9) were 0.974 and 0.967 respectively. These ratios were significantly higher than males (0.968 and 0.958 for groups aged (0 – 4) and aged (5 – 9) respectively) (Table 1 and 2). Therefore, assuming that there was the same number of males and females were born during 1999-2009, it is expected to have more females aged (0 – 9) enumerated in the 2009 Census than males.

Table 1: The survival ratios of females aged 0 – 4 and 5 – 9

Age group	x	l_x	$_nL_x$	T_x	e_x
<1	0	100,000	98,800	6,864,000	68.64
1-4	1	97,862	388,201	6,765,200	69.13
5-9	5	96,856	483,587	6,376,999	65.84

$S_{0-4} = L_0 / 5*l_0 = (L_1 + L_0)/ 5*l_0$ = (98,800 + 388,201)/ 5*100,000 = 0.974

$S_{5-9} = L_5 / 5*l_0$ = 483,587/ 5*100,000 = 0.967

Note: the results were rounded

Table 2: The survival ratios of males aged 0 – 4 and 5 – 9

Age group	x	l_x	$_nL_x$	T_x	e_x
<1	0	100,000	98,160	6,465,000	64.65
1-4	1	97,174	385,682	6,366,840	65.52
5-9	5	96,052	479,101	5,981,158	62.27

$S_{0-4} = L_0 / 5*l_0 = (L_1 + L_0)/ 5*l_0$ = (98,160 + 385,682)/ 5*100,000 = 0.968

$S_{5-9} = L_5 / 5*l_0$ = 479,101/ 5*100,000 = 0.958

Note: the results were rounded

The numbers of male and female births during 1999-2009

It is assumed that the children aged (0 – 9) in 2009 experienced the survival ratio of children aged (0 – 9) in the 1999 life table. Then, the actual numbers of live births each five-year in the period prior to 2009 were calculated by the numbers of children in 2009 divided by the corresponding survival ratios. In our calculation, we found that the number of male births was significantly higher than the number of female births by 570,007 which resulted in the imbalance sex ratio (108.4). In addition, the actual SRB increased according to the birth cohorts, which were 107.3 for the cohort 1999-2004 and 109.4 for the cohort 2004-2009 (Table 3).

Table 3: The actual numbers of male and female births during 1999-2009

Age in 2009	Enumerated in the Census 2009		Survival ratio		Actual male births 1999-2009	Actual female births 1999-2009
	Male	Female	Male survival ratio	Female survival ratio		
	(1)	(2)	(3)	(4)	(5)=(1)/(3)	(6)=(2)/(4)
0-4	3,662,889	3,371,255	0.968	0.974	3,785,212	3,461,241
5-9	3,458,159	3,252,578	0.958	0.967	3,609,007	3,362,971
Total	7,121,048	6,623,833			7,394,219	6,824,212

Note: the results were rounded

Table 4: The number and percentage of sex-selective abortions during 1999-2009

Age in 2009	Actual male births 1999-2009	Actual female births 1999-2009	Actual SRB	Normal SRB	Expected female births 1999-2009	Missing	
						SSA	%
	(1)	(2)	(3)=(1)/(2)	(4)	(5)=(1)* 100/(4)	(6)=(5)-(2)	(7)=(6)/(5)
0-4	3,785,212	3,461,241	109.4	105	3,604,964	143,723	4.0
5-9	3,609,007	3,362,971	107.3	105	3,437,150	74,179	2.2
Total	7,394,219	6,824,212	108.4	105	7,042,114	217,902	3.1

Note: the results were rounded

The expected number of female births and the number of SSAs during 1999-2009

Assuming that there had been no imbalance SRB in Vietnam during 1999-2009, the normal SRB would have been 105 but this study showed the actual SRB was much higher. Therefore, we calculated the expected number of female births by diving the number of male births to 105. With an assumption that males were fully enumerated in the 2009 Census, the gap between the actual and the expected numbers of female births was the number of SSAs. As shown in Table 4, the number of missing girls due to SSA was 217,902 during 1999-2009 in Vietnam, accounted for 3.1% of the total female births (7,042,114). Consequently, there were on average 21,790 abortions due to SSA per year for 1999-2009.

4. DISCUSSION

The validity of the estimation method

It is important to mention the validity of the estimation method to indicate how accurately the results of this study reflect the real situation in Vietnam and four aspects have been discussed including the methodology, the assumptions,

the quality of the data sources, and the consistency of the study results with prior studies.

Methodology

The reverse survival method is simple and produces fertility estimates that are very sensitive and consistent with the original values of the population, while the data requirements are not too onerous. This method can be applied to a huge body of existing and available population data – both contemporary and historical – that has remained largely under-exploited [7]. In addition, this method is recommended in estimating fertility by the United Nation and International Union for the Scientific Study of Population [8, 13]. Therefore, applying this technique can provide the accurate number of births in the specific period since the selected year, which was needed to estimate the number of SSAs in this current study.

Moreover, this study has an advantage when applying the life table and the survival ratio to get a more accurate number of missing girls due to SSA. While the previous studies on estimation of the number of missing girls did not consider the difference in the mortality rate and the population structure between countries when they compared sex ratios by age, it was just a snapshot on the differences in the sex ratio between countries [1, 14].

Assumptions of the method

The first assumption was no migration of children aged (0 – 9) during 1999-2009 in Vietnam. It is a fact that most migrants were at working ages, so groups in early age of life, such as at (0 – 9) years old, are less likely to migrate oversea, except for a small number of those whose parents migrate. Thus, the assumption of no migration of children aged 0-9 during 1999 to 2009 is not significantly violated by this study.

The second assumption was a full report of males aged (0 – 9) in 2009 Census of Vietnam. In fact, there was underreporting of the population aged (0 – 4) in the 2009 Census, but the estimated percentage of underreported rate by sex was not provided in the final report. However, the undercount rate of the whole country was quite low (1.5%), and girls tended to be undercounted more than boys in general [15]. In addition, another national report compared the child population aged (0 – 4) as recorded in the Census and the estimated child population during the five years prior to the Census showed that the recorded number was higher than estimated for both sexes, and the difference among male children was higher than among female children. It means that males were more likely to be counted than females. Thus, males were likely to fully report in the 2009 Census.

In addition, with male preference, couples can select the sex of the child by using In Vitro Fertilization (IVF) in conjunction with Preimplantation Genetic Testing (PGD). This technique can choose accurately a sperm that contains a Y chromosome or an embryo that has XY chromosomes to get more male fetus. Even this action is obviously prohibited by laws in Vietnam but it seems out of control of the law in practice. However, most people find IVF when they have reproductive health problems. The percentages of primary and secondary infertility were roughly low in the community, with about 2% and 10% respectively [16]. Evidence showed 77.5% infertile couples did not have a gender preference, 20% preferred a son, and 2.5% a daughter [17]. Among all causes of sex-selective abortion, son preference is the root one. Thus, when there is no a gender preference, using IVF to have a son will not be likely happen, because it is costly and time-consuming. Therefore, choosing more male chromosome than female one via IVF and PGD less likely affected this study assumption, especially in the period of 1999-2009 when these techniques were still less common. However, this problem should be seriously considered for the next period of estimation.

Quality of the data sources

We obtained the number of males and females from the 2009 national Census, which has been considered the most reliable and up to date nationally representative data in Vietnam. In addition, the survival ratios were calculated from the WHO's life table, which was based on the national data of Vietnam, including the Demographic and Health Surveys in 1988 and 1997, and the 1989 Census [11].

Consistency of the study results with prior studies

The study results would have been more reliable if we could compare with national relevant numbers. However, in this paper, this would not be possible because the information on population structure were first published by the Statistical Office of Vietnam since 2007 on their website. It was difficult to find the number of children were born during 1999-2006, therefore, we just compared with the estimation of the United Nation only. This current study found that the total number of births was 14,218,430 for 1999-2009 in Vietnam, which was similar to the UN's estimate of 14,271,000 births for 2000-2010[1] [18].

Further discussion on SSA in Vietnam

It is a fact that, Vietnam is one of the countries with the highest abortion rates in the world. In Vietnam, there are two terms regarding abortion, including abortion ("pha thai") and menstrual regulation ("dieu hoa kinh nguyet"). The term of abortion indicates the pregnancy termination undergoing at the later stage of gestation which is from 7th weeks to 22nd weeks. While menstrual regulation is referred to an early abortion occurring 6th weeks or less after the beginning of women's last menstrual period. At this stage, the fetus is not yet formed so it is more tolerant for the women to terminate the pregnancy compared to abortion [19]. Thus, SSA is more related to the practice of abortion rather than menstrual regulation because it is impossible to determine the sex of fetus via ultrasound scan during the first six weeks of pregnancy. According to the statistics reported in Table 5, we have calculated the average number of abortions due to all reasons, including SSA, was 184,348 per year[2] for the period of 2001-2006 in Vietnam.

[1] The statistics were obtained from the World Population Prospect. They reported that the total number of births were 6,891,000 for 2000-2005 and 7,380,000 for 2005-2010. Therefore, the total number of births for 2000-2010 was 14,271,000

[2] The data of the third column of Table 5 showed the number of abortions excluding the menstrual regulation. Thus, the average number of abortions was calculated using the sum of abortions from 2001 to 2006 divided to 6.

In this study, for the first time we have found that the average number of abortions due to sex-selection was 21,790 per year for the period of 1999-2009. Consequently the SSAs approximately accounted for 11.8% of total abortions in Vietnam. This percentage is considerably lower than that of China (36%) and India (17%), the two highest SRB in the world [20].

Table 5: Number of abortions in Vietnam for 1999-2012

Year	Menstrual regulation	Abortion	Total	Source
1999	//	//	780,000	Thinh [21]
2001	421,701	196,627	618,328	
2002	404,340	167,955	572,295	
2003	365,872	174,505	540,377	
2004	346,988	243,643	590,631	
2005	359,956	179,764	539,720	
2006	345,482	143,594	489,076	
2007	//	//	26,932	GSO [22]
2008	//	//	161,016	GSO [23]
2010	//	//	127,034[+]	GSO [24]
2011	//	//	96,068[+]	GSO [25]
2012	//	//	88,783[+]	GSO [26]

[+] Number of married women who had at least an abortion.
// Not available

Surprisingly preference for sons has not led to discriminatory treatment of females after births in Vietnam, which commonly occurs in India [9]. Mortality rates for boys have been substantially higher than for girls in Vietnam. The infant mortality rate as well as under five mortality rate for girls were always lower than for boys from 2009 to 2012 [26]. Since boys are more involved in risky behaviors, accident and violence in early ages of life [27]. Therefore, it is suggested that most missing girls in Vietnam have occurred before birth due to SSA, rather than after birth. Reducing SSA is a crucial intervention to lower the missing girls in Vietnam.

Policy gaps

The first policy gap is the prohibition law of SSA was initiated in the context of legal abortion in Vietnam. Health providers generally provide abortion services on request of the mothers. The Law on Protection of People's Health mentions: "women have the rights to have an abortion" [28]. Therefore, Vietnamese women can have an abortion on request up to 22nd weeks of gestation [4]. At the beginning, ultrasound scans were used in most health centers in Vietnam to monitor the health of pregnant women, but later such scans have become the most common mean to know the sex of the fetus. Women go to the health center for a routine medical check in their 12th weeks of pregnancy, either by chance or on purpose, learn the sex of their fetus [25]. And those who are hoping for a son will undergo an abortion if the fetus is a girl without reporting the true reason to the health consultant. According to Truc, among 381 pregnant women having abortions, no one expressed sex-selection as the reason for abortion, the most common reasons were insufficient economic resources, already having two children, and health problems of the mother [29].

This situation raises a concern about the second policy gap, which is how can women know the sex of the fetus after an ultrasound scan when the health providers are not allowed to inform them. The women may not be afraid to ask about the sex of their fetus because they are not subject to any punishment. The regulations just targeted the health providers who perform ultrasound scans and inform pregnant women, and those who force women to have an abortion because of sex-selection [30]. The percentage of women knowing the sex of the fetus before birth increased continuously from 63.8% in 2006 to 81.3% in 2012 [25, 26]. Thus, health provider must inform women the sex of the fetus in an informal way without recording in medical report, which seems to be out of control of the law.

This study has found that the number of sex-selective abortions has nearly doubled from 74,179 in 1999-2004 to 143,723 in 2005-2009. It can be seen that the number of SSA did not decline after the first law was introduced in 2003 and higher penalties were enacted in 2006. The policy gaps mentioned above partly explained the positive reasons that have made the laws and many government intervention efforts ineffective. However, incomplete and insufficient monitoring of law and delaying in punishments for prohibited behaviors are responsible for the increasing trend of SSA in Vietnam.

Limitations of the study

The findings of this study have to be seen in light of two limitations. First, we did the estimation for the period of 1999-2009 which was less likely to provide up-to-date practical solutions to the current management of population program in Vietnam. However, the estimation of SSAs for 1999-2009 is necessary because this period included the time that the first law on sex-selective abortion prohibition was enacted in 2003. Thus, we could evaluate how the national law worked in practice and discuss some possible reasons of this fact. Based on the lesson in the past, the current health providers could choose more effective ways to reduce the high SRB in Vietnam. Second, the lack of national data in the period of 1999-2009 limited us to compare the study results with relevant figures published by the Statistical Office and strengthen the reliability of the estimation. However, future research could solve these limitations because at that time the national data would be more update, adequate and accessible.

Conclusion

The study proves that sex-selective abortions remains pronounced in Vietnam. We need a long-run plan to bring the SRB to the normal level. In the context of Vietnam, changing the social norm regarding female values and roles in both family and society is the key solution to end this problem. We recommended that the government should put more attention on monitoring and evaluating the implication of the law. The prohibited behaviors on prenatal sex-selection need to be informed more widely to the community. The research to estimate the number of SSAs in Vietnam for the next coming period should be conducted when the 2019 census data is available and do the analysis at provincial level.

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APPENDIX:

Vietnam Life table in 1999

Male

x	${}_nM_x$	${}_nq_x$	l_x	e_x
0	0.029	0.0283	100,000	64.65
1	0.0029	0.0115	97,174	65.52
5	0.001	0.0052	96,052	62.27
10	0.0008	0.0041	95,555	57.58
15	0.0014	0.0068	95,159	52.81
20	0.0018	0.0089	94,515	48.15
25	0.0017	0.0087	93,679	43.56
30	0.0024	0.012	92,863	38.92
35	0.003	0.0149	91,749	34.36
40	0.0042	0.021	90,384	29.84
45	0.0068	0.0333	88,487	25.43
50	0.0112	0.0546	85,539	21.22
55	0.0185	0.0884	80,871	17.3
60	0.0316	0.1464	73,724	13.74
65	0.0511	0.2265	62,928	10.66
70	0.0827	0.3426	48,676	8.05
75	0.1322	0.4968	32,000	5.95
80	0.2039	0.6754	16,101	4.35
85	0.3119	1	5,227	3.21

Female

x	${}_nM_x$	${}_nq_x$	l_x	e_x
0	0.0218	0.0214	100,000	68.64
1	0.0026	0.0103	97,862	69.13
5	0.0006	0.0032	96,856	65.84
10	0.0005	0.0026	96,550	61.04
15	0.001	0.0048	96,298	56.19
20	0.0013	0.0066	95,839	51.45
25	0.0012	0.0062	95,209	46.77
30	0.0015	0.0077	94,617	42.05
35	0.0018	0.009	93,892	37.35
40	0.0027	0.0133	93,046	32.67
45	0.0043	0.0215	91,807	28.08
50	0.0073	0.0357	89,836	23.64
55	0.012	0.0581	86,626	19.42
60	0.0215	0.102	81,591	15.47
65	0.0372	0.17	73,265	11.94
70	0.0671	0.2873	60,811	8.87
75	0.1138	0.4429	43,338	6.44
80	0.1881	0.6398	24,145	4.57
85	0.307	1	8,698	3.26