**Research Article**

# Factors Associated With Sex Ratio at Birth

## Bharati K*, Akade SV and Durgawle PM

*Krishna Institute of Medical Sciences Deemed University, Karad, India*

*Corresponding author: Kaveri Bharati, Krishna Institute of Medical Sciences Deemed University, Karad, India, E-mail: drkaveri11@gmail.com

## Abstract

One of the most significant features of the twentieth century is the dramatic decline infertility and explicit preference for smaller families in most parts of India. The present study was undertaken to find determinants responsible for this declining sex ratio.

**Keywords:** Sex Ratio; Birth

## Introduction

A sloka of Atharvaveda says, "The birth of a girl, grant it elsewhere. Here grant a son". This saying stands very true in modern times as well, when, despite the so called improved modernity, industrialisation, literacy and equality, parents still pray this [1].

One of the most significant features of the twentieth century is the dramatic decline in fertility and explicit preference for smaller families in most parts of India. However, this rather than reducing has exacerbated the preference for a son, leading to an increased discrimination against daughters.

Declining sex ratio i.e. ratio of females to males in a population indicates an inhuman attitude towards females. The most disturbing and alarming aspect of the census report 2001 of India is the sharp fall in sex ratio from 972 in 1901 [2] to 933 in 2001 [3] and to 927 in 2008 [4]. However sex ratio at birth for India for the period 2004-06 (3 years average) has been estimated at 892 varying from 895 in rural areas to 881 in urban areas5. In the list of 218 countries, India ranks 199 with sex ratio (males: females) at birth 1.123. In the absence of any intervention, the sex ratio at birth is consistent across populations at between 103 and 107 boys born for every 100 girls [5]. The child sex ratio in states such as Punjab and Haryana, which have the highest per capita income, is as low as 808 [6] and 820 [7], respectively. Sirhind in Fatehgarh Sahib (Punjab) has the lowest child sex ratio of 766 per 1000 males as per 2001 census [4].

The unfavorable ratio of a girl child could be attributed to gender selective abortion, thereby interrupting the natural course of reproduction. Factors that compel people to favor a male offspring are social in origin [8]. Indian scenario of female discrimination is extremely complex in view of India's social and economic diversity: the interplay of cultural and economic factors and abortion practices – at various scales of analysis (state, district, municipalities) and for many different subpopulations (classified by age, religion, literacy rate, etc.) has affected sex ratio at birth [9].Changing sex ratios among children are going to have a lasting impact on population dynamics in India, as most of today's births will survive for more than 60 years. In the case of masculinization, we are hardly in a better position, since decreasing sex ratio at birth (SRB) is a trend that has never been documented in the past, anywhere in the world [9]. Decreased sex ratio at birth reflects the impact that a lack of women would have on fertility potential: fewer women today translates into fewer births after 20 years.

The decreased sex ratios are seen in countries with a combination of preference for sons, easy access to sex selective technology, and a low fertility rate, as births of girls must be prevented to allow for the desired number of sons within the family size [6]. Prenatal sex selection with ultrasound followed by second trimester abortion is one of the ways sex selection manifests itself. Maintaining access to safe abortion and achieving a raise in low sex ratio are both important goals and this is possible only if the focus shifts to addressing the conditions that drive son preference.

Therefore this study was undertaken to assess the attitude of mothers towards their preference for the gender of children, its effect on reproductive behavior and determinants responsible for this declining sex ratio.

## Aims and Objectives

- To find out sex ratio among newborns
- To study impact of sociodemographic factors on sex ratio
- To study variables discriminating male and female newborns
- To detect variables that could balance sex ratio

## Review of Literature

In the study by Indira Dey et al. [7] conducted in the rural area of west Bengal found that majority (62.8%) of mothers considered two to be the ideal number of children with ideal gender composition of the children being one son and one daughter as considered by 53.8% of mothers. However, 32.7% of mothers desired for more sons than daughter, while only 3.8% of mothers wanted more daughters than sons. Among mothers with living children, all the mothers with daughter(s) and no son, desired for another child and that should be a male. Whereas of mothers with only one son, 8.7% didn't want another child and 43.5% of them desired another son while remaining (47.8%) wanted a daughter. Among mothers with two or three living children, the proportion of mothers not desiring any more children increased with increase in the number of living sons. In case of mothers with two children, only 15.4% of mothers with two daughters had undergone sterilization, while 84.6% of mothers with two sons are using contraceptives. It has been observed that in rural India, 37% of the married women wanted more sons than daughters but only 2.1% of them wanted more daughters than sons. Desire for the next child to be a boy (39.2%) was greater than the desire for a girl child (8.3%) in the next pregnancy. Although at primi parity and second parity, this effect was minimal since women were still actively involved in the process of family building but beyond parity two, additional fertility was more closely associated with the surviving number of sons. This study also revealed that the percentage of women using a contraceptive method increased with the increase in the number of living sons irrespective of the number of living children.

In NFHS 2 study [10], 47% women wanted the next child to be a boy as compared to only 11% of those who wanted next child to be a

girl. However in this national survey, 42% of the mothers who wanted another child said that the gender of the child does not matter.

Malhi et al. [11] reported a strong son preference in urban Himachal Pradesh. They found that at parity two, not a single woman with two daughters desired to terminate child bearing, while an overwhelming majority (86.5%) of women with one son and all women with two sons didn't want another child. Even at parity four and above, woman who had no living sons did not want to terminate child bearing. At each parity, contraceptive acceptance was higher among women who had one or more living sons.

As per the article declining sex ratio in Orissa, sex ratio at birth [12] in all populations is higher (about 105) favoring the male. The technological changes in agriculture preferred male to female labor since men were considered more efficient and more suited particularly in high technology innovation. Men could work for longer hours at a stretch and were more suitable for group operations, compared to women. In urban areas where the urban sex ratio is more for male, it may be safely assumed that urban women prefer sex determination as the facilities are available in urban centers and that urban women are under constant stress to reduce the family size, compared to her rural counterpart.

Murthy et al. [13] have analyzed that higher female labor participation reduces the extent of gender bias in child survival.

As per the tribune article [14], poverty is a huge constraint in the way of birth and development of a girl child.

As per the article by Bandyopadhyay et al. [8] most of the factors that compel people to favour a male offspring are social in origin. With the average family size decreasing rapidly and preference for male child remaining the same, the female population is showing a downward trend. Various methods are adopted by people to get a son. Sex determination tests and female feticide are still reported. It seems that because of the strong desire to have a son, people wish to exercise some choice regarding the sex of their child in their small family by resorting to sex selection techniques.

As per population foundation of India [4], obsession for son is prevalent in all income groups, education groups irrespective of caste and creed. Continuation of family lineage, performance of certain religious and social functions, performance of last rites, and expectation to provide financial, emotional and social support at old age are some of the factors.

As per Aggarwal et al. [15], hard tasks like ploughing in fields are very difficult for females, and sons are important assets in such situations. Who will look after them when the parents lose their strength with age? Thus the gender disparities exist despite educational status and financial independence.

As per MohitSahni et al. [16] the sex ratio at birth can be used to examine the influence of antenatal sex selection on the sex ratio. The sex ratio in the second child was significantly lower if the first child was a girl. Sex selective abortions after antenatal sex determination are thus implicated.

As per Chakraborty et al. [17] child sex ratio is inversely related to the spatial socio-economic characteristics, in particular female literacy rate and female economic activity rate, with relatively higher elasticity coefficients for urban India. The monotonic decline in the juvenile sex ratio over the last four decades despite the socio-economic characteristics reinforces the existence of gender discriminatory practices, which starts even before birth.

As per the article [18] Social analysis of sex ratio in the journal of epidemiology and community health, the odds of having a male infant increased with income quartiles. Heads of household with post-secondary education had a higher odds ratio of having a male infant than those with no formal education. The odds of having a male infant did not differ between high and low caste groups, and was not associated with the educational attainment of the spouse.

As per the article Sex ratio continues to slide in Australian bioethics information [19], the gap between girls and boys is accelerating, especially amongst the wealthier and better educated.

As per the article sex ratio at birth begins to improve in India in the population reference bureau [20], Sex-selective abortion has been primarily used by wealthier Indians who can afford the ultrasound fee of 500 rupees ($US12) to determine the sex of a fetus. The increasing availability of ultrasound has been linked to the sharp rise in the ratio of male births to female births in some parts of India in recent decades. The preference for sons has deep roots in India for cultural and economic reasons. Once a daughter marries, she leaves the parental home to live with her in-laws. She is perceived to be of little economic benefit to her parents and will not support them in their old age. Having a girl is like "watering your neighbor's garden," according to a common Indian saying. A daughter's wedding can be a financial drain for parents: The payment of a sometimes extravagant dowry to a groom's parents remains virtually universal despite laws against dowry that date to 1961. Now-banned advertisements for sex determination tests, such as "Invest only Rs. 500 now and save your precious Rs. 50,000 later," reminded parents of the future expense a daughter would bring. A further motivation for a son over a daughter is the belief among Hindus that it is essential for a son to perform rituals at his parent's cremation and at every death anniversary thereafter. Often, the combination of available family funds for an ultrasound test and low fertility will exacerbate the sex ratio problem. When couples limit their family to two children and they want to make sure that at least one is a boy, they may be more open to aborting a female fetus. The pressure to have a son is often felt most intensively by young wives, who want to please their husband's family

As per the article India's falling juvenile sex ratio by Deolikar [21], the imbalance in India is acute which might be indicative of prenatal sex-selection by parents, whereby the parents choose to abort female fetuses based on prenatal ultrasounds. An imbalanced juvenile sex ratio can also arise when parents use contraceptives differentially depending upon the sex composition of their existing children, such as using contraceptives only after having had a son. All three behaviors reflect a strong cultural preference among Indian parents for sons over daughters. These cultural differences manifest themselves in the form of lower sex ratios at birth in the northern and western states than in the southern and eastern states. A worsening of the juvenile sex ratio with increased female education and literacy. A possible explanation for this has to do with the negative effect of female literacy on fertility. Educated women tend to have fewer children than less-educated women, and in the context of a strong son-preference culture, the lower levels of fertility lead to greater pressure on couples to have boys instead of girls. This relationship between fertility decline and lower juvenile sex ratios has been observed in other countries with strong son-preferences. The right of inheriting ancestral property to only males especially among Hindus has favored sons over daughters.

As per the article gender bias in sex ratio [22], the effect of an increase in education on female disadvantage at birth is not so straightforward. More education may increase the couple's awareness of the possibility of using prenatal sex detection. A deep-rooted preference for males is thought to be the main reason for gender bias in the sex ratio, and the sex ratio at birth in particular. A couple may develop a preference for sons due to a historic background of female disadvantage. There is kinship structures (dowry system, women moving away from their parents' home at marriage) in which the daughters of the family entail a higher future cost than sons do. The dowry system, for example, consists of the payment of revenue by families in order to have their daughters (not their sons) married. If they have to pay a dowry, an already poor family may be pushed into dire poverty. Although this kinship structure is now illegal in India, dowry practices continue to survive. The expansion of prenatal sex determination now enables families to choose the sex of their new child by practicing abortion when the fetus is not of the desired sex.At the same time, it is noticed that fewer women are born in urban areas than in rural ones. Certainly, urban areas currently have better access to modern medical techniques. It is recognized that the lack of education among poor people constitutes one of the main obstacles to their making use of income growth. Lack of education may be a major impediment preventing individuals from making use of, say, and sex-selective abortion technology. Education increases a person's autonomy to act. Fewer female births occur in areas with scarcer independent income opportunities for females. The result evidences that the decline in female births due to awareness of new technology is greater than the increment in female births caused by a weakening of son preference. Fewer female births occur in areas with scarcer independent income opportunities for females. This strengthens our belief of there being a very deep-rooted preference for sons, which counteracts the (possible) positive effect of education on female survival.

As per article high sex ratio at birth [23], prenatal sex detection with ultrasound followed by second trimester abortion is one of the ways sex selection manifests itself, but it is not the causative factor.

As per article missing women [24], For India, we use a reference ratio between 1.059–1.066. The several cultural and economic factors that systematically discriminate against women lie at the heart sex ratio at birth, which may be indicative of practices such as selective abortion following pre-natal sex detection. In India, the ratios of males to females for second and third-order births, conditional on the previous births being female, are extremely high. Missing women have been defined as the number of girls who have died due to discriminatory parental preferences. 11% of the total missing women in India occur before birth. This is problematic for a simple reason: there appears to be substantial variation in the sex ratio at birth across race and ethnicity. A number of behavioral, biological, and environmental factors can explain part of the variation in sex ratios at birth. The proportion of male births increases with the number of prior births and shorter birth intervals and it decreases with parental age and the proportion of multiple births.

According to Proximate sources of population sex imbalance in India by Emily Oster25, they focus on the relative contributions of factors such as female labor force participation and female education in determining overall sex ratios.

According to the article a skewed demographic shift in the Wall Street journal26, the imbalance in India is acute and is indicative of prenatal sex selection by parents, whereby the parents choose to abort female fetuses based on prenatal ultrasounds. An imbalanced juvenile sex ratio can also arise when parents use contraceptives differentially, depending upon the sex composition of their existing children, such as using contraceptives only after having had a son.

As per the article characteristics of sex ratio imbalance in India and female scenario by Guilmoto [9], Indian scenario of female discrimination is extremely complex in view of India's social and economic diversity: the interplay of cultural and economic factors and abortion practices – at various scales of analyses (state, district, municipalities) and for many different subpopulations (classified by age, religion, literacy rate, etc.) has affected sex discrimination – such as sex ratio at birth. Parents want to avoid the "worst-case "scenario-i.e. a family without a son. This is reflected in the sex ratio of higher parity births. While proportion of these amount to less than a quarter of all pregnancies, among these the sex ratio at birth may jump to values of 130 or more, roughly indicating an excess of 25 male births out of a total of 230. These additional male births have probably followed one or more abortion attempts. In India, pre natal sex determination relies mostly on ultrasonography and is reliable after 14-16 weeks of gestation. The number of abortions that take place in India is poorly known, especially because many terminations take place outside registered centers and are performed by uncertified providers (who may, however, often be medical practitioners). Estimates vary from 13 to 21 per 1000 births, based on large-scale surveys and state statistics, while micro-level studies may provide lower estimates. The combination of new technologies for pre-natal sex determination and abortion proved to be a dramatic cocktail, which would quickly become an efficient sex-selection device. A further advantage lay in the shortened duration of the process of sex selection, as families did not have to wait until delivery. While still traumatic for many women, abortion was considered far less physically or psychologically painful than a pregnancy followed by infanticide, or later infant or child deaths. An early abortion allows women to avoid exposure from others outside their immediate family members. Many couples could therefore conceal their pregnancy, and implement their sex-discrimination strategy, with little scrutiny from the community at large. Other family members, such as the father or his parents, also understood its potential for sex selection, and encouraged women to overcome their physical or psychological reservations on abortion if they wanted to avoid the birth of a girl. A ratio favorable to boys and adverse to girls coincides with the introduction of modern prenatal sex-determination methods. SRB appears close to its normal value. This is the case for first births, for instance, for which sex ratio is often very close to normal values. Most families do cherish diversity, after all, and do not shun the birth of an initial daughter. Similarly, births that follow the birth of a son may not be greatly affected by sex selection. Parents want to avoid the "worst-case" scenario – i.e., a family without a son. This is reflected in the sex ratio of higher-parity births. The additional male births have probably followed one or more abortion attempts. An additional dimension that emerges from this analysis springs from socio-economic differentials. Researchers have already seen that higher sex ratio is observed in urban India as compared to the country's villages. But further analysis also points to the positive linkage between abnormal sex ratio and better socio-economic status and literacy. This contradicts the spontaneous explanation of sex selection being an archaic practice common only among the uneducated. In fact, it can even be shown that, all other things being equal, female literacy and other economic indicators tend to increase the sex ratio of children being even higher among the most educated women. The parents can enjoy constant financial and emotional

support from their sons' families, whereas married daughters are not supposed to contribute to their parents' expenses after marriage. The sons living in the vicinity represent a source of protection and affection for their parents. Sons are vital to continue the family lineage (gotra), and often the family activities. Since daughters are usually excluded from an equal share of the inheritance, surviving boys are assured to inherit their parents' property, and will carry on the family name.

Sons also to perform the requisite rituals upon the death of their father (such as lighting the funeral fire), a task from which women are customarily excluded. The prominent role of sons within the patrilineal system has, of course, added prestige to their status, and is a common source of pride for parents. On the other hand, sonless parents may feel permanent anguish in the face of their family's and community's reaction. The high-ranking communities (typically high castes among Hindus) and high-income groups (typically the landed peasantry or urban middle classes) will be especially responsive to demands related to ritual, reputation and financial exchange. Lower-status or lower-income groups, such as backward castes or tribal populations, are therefore in a different position, and son preference in these communities is usually less acute than in the rest of society.

As per the article economics, cultural transmission and the dynamics of sex ratio at birth in china [20], culture is intricately linked with the economic reality of each couple's life, so that there are financial and psychological repercussions to parents who have no sons. The economic necessity, for instance in rural areas where the need for manual labor is great, it is also traceable to deeply rooted practices and cultural beliefs. Examples are the continuation of the family lineage, restriction of certain funeral practices to sons of the deceased, and the widespread practice of virilocal marriage (in which a bride goes to live in her husband's household). Many couples make the second choice by means of sex-selective abortions and infanticide, thus contributing to the abnormally high ratio of male to female children. In China, the problem has been exacerbated by the availability of ultrasound technology that allows the parents to determine the sex of a fetus although this technology is illegal for sex determination; its use for this purpose is widespread. In models of transmission of son preference, a certain percentage of women choose to pursue sex selection to ensure that at least one of their children is male. Economic value is that which is readily translatable into money. It includes the value of the child's manual labor over his or her lifetime, the support of parents in their old age.

The value of continuing the family's surname in future generations, and the value of knowing that the family's ancestors will be remembered for years to come. We assume that a mother can translate the cultural value of her child into the currency of economic value and that shortly after its birth she accurately assesses the child's total value-cultural and economic combined. The sex ratio is also extremely male-biased.

In the article China's Excess Males, Sex Selective Abortion, and One Child Policy: Analysis of Data From 2005 National Intercensus Survey by Wei Xing Zhu; Li Lu; Therese Hesketh6, the sex ratio at birth was close to normal for first order births but rose steeply for second order births, especially in rural areas, where it reached 146 (143 to 149). Sex selective abortion accounts for almost all the excess males. One particular variant of the one child policy, which allows a second child if the first is a girl, leads to the highest sex ratios. In the absence of intervention, the sex ratio at birth is consistent across populations at between 103 and 107 boys born for every 100 girls. The selection for males prenatally with ultrasonographic sex determination and sex

selective abortion has been possible. This technology has become widely available in many countries, leading to high sex ratios from birth. The highest sex ratios are seen in countries with a combination of preference for sons, easy access to sex selective technology andlow fertility, as births of girls must be prevented to allow the desired number of sons in the family.

## Material and Methods

The study was conducted in Krishna Hospital and medical research Centre, Karad of western Maharashtra, a teaching hospital.

All the live newborns, their mothers and care taking relatives, in the Department of Obstetrics and Gynecology were included the study. Mothers with past and present twin issues were not a part of the study. Data was collected from respective eligible subjects during two months from May1, 2009 to June 30, 2009. Data on social and demographic factors of mother and father along with the opinion of their relatives regarding sex of the newborn was collected. The detailed information regarding the mothers past obstetric history was also collected after the due consent of the mother.

Later the complete data was compiled and a master chart was formed. The data was summarized and analyzed using statistical software, SPSS - Version 16. Chi square test and unpaired't' test was applied to assess significance of association and difference, respectively. Association and difference was said to be significant when p was less than 0.05. Logistic regression analysis was carried out to find factors significantly associated with male newborns.

## Results

During period of two months there were 260 deliveries in the Dept. of Ob. Gyn., Krishna Hospital, of Krishna Institute of Medical Sciences, Karad, Maharashtra; a teaching hospital. Out of these 260 newborns, 145 (55.8%) were males and 115 (44.2%) were females. The sex ratio (female/male) was 0.79 signifying greater incidence of male children compared to female.

Of 224 mothers from rural area, 124 (55.4%) gave births to male babies while 100 (44.6%) gave birth to female babies. And of remaining 36 mothers from urban area, 21 (58.3%) gave births to male babies while 15 (41.7%) gave birth to female babies. Prevalence of males was greater in both the rural and urban areas signifying greater incidence of males irrespective of the area ($\chi^2$=0.111, P=0.739).

Mothers age for both male and female births held no significant difference (t= 0.950, p=0.343), however, fathers age is found to be comparatively greater for males compared to females (t=1.679 p=0.094). Number of family members bears no relation with the sex of the newborn (t=0.128 p=0.898). Family income also bears no impact on sex of newborn (t=2.608 p=0.190). Time since marriage among parents of male newborns was significantly more than parents of female newborns (t=2.608 p=0.010). (Table 1) indicating a possibility of missing female babies due to possible abortions of selective female fetuses and afterwards having a baby of desired male sex.

For all birth orders there is preponderance of male babies; implying increased tendency of male birth with successive birth order ($\chi^2$= 2.579 p = 0.631) (Table 2). At each birth order proportion of male newborns is higher than proportion of female newborns. However, comparison of male newborns, that up to second birth order and after that; 120 (54.3%) and 25 (64.1%), respectively revealed that after

second birth order there was high proportion of male newborns ($\chi2=1.292$, p=0.256).

The mean birth spacing amongst male newborns was 2.5 years with standard deviation 1.96 years and that amongst female newborns was 2.1 years with standard deviation 1.4 years. The difference in birth spacing was borderline significant (t=1.896, p=0.059).

Out of 260 mothers 4 had a problem of sterility due to medical reasons. Remaining 256 mothers revealed that irrespective of use of contraceptives, the proportion of male newborns was higher (Table 3). But still higher proportion male newborns was found amongst those who used contraceptives than who didn't use ($\chi2=1.152$, p=0.283).

| Newborn Sex | | Age | | Family Members | Family Income | Married Years |
|---|---|---|---|---|---|---|
| | | Mothers | Fathers | | | |
| Male | N | 145 | 145 | 145 | 145 | 145 |
| | Min | 18 | 22 | 3 | 750 | 1 |
| | Max | 31 | 40 | 25 | 40000 | 16 |
| | Mean | 23.1 | 28.2 | 7.02 | 6138.6 | 4.1 |
| | Std. Dev. | 2.84 | 3.8 | 3.1 | 5745.9 | 3.3 |
| Female | N | 115 | 115 | 115 | 115 | 115 |
| | Min | 18 | 20 | 3 | 1000 | 1 |
| | Max | 32 | 38 | 17 | 60000 | 13 |
| | Mean | 22.7 | 27.5 | 6.97 | 7377.8 | 3.1 |
| | Std. Dev. | 2.85 | 3.4 | 2.7 | 9344.2 | 2.3 |

**Table 1:** Summary of demographic variables of families.

| Newborn Birth Order | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| 1 | 76 (55.1) | 62 (44.9) | 138 |
| 2 | 44 (53.0) | 39 (47.0) | 83 |
| 3 | 20 (60.6) | 13 (39.4) | 33 |
| 4 | 4 (80.0) | 1 (20.0) | 5 |
| 5 | 1 (100.0) | 0 (.0) | 1 |
| Total | 145 (55.8) | 115 (44.2) | 260 |

**Table 2:** Birth order wise sex of newborn.

With increasing no of pregnancies, the proportion of males goes on increasing ($\chi^2=3.012$, p=0.556) (Table 4). It signifies more births for more males. Findings in Table 2 and Table 4 coincide a lot.

Of total 260 newborns born to mothers irrespective of their gravida, majority are found to have their first USG being done between 3 to 7

months and out of these 59.1% are found to be male births. This is found to be statistically noticeable. ($\chi2=5.504$, p=0.064)(Table 5).

| Use of Contraceptives | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| Yes | 17 (65.4) | 9 (34.6) | 26 |
| No | 125 (54.3) | 105 (45.7) | 230 |
| Total | 142 (55.5) | 114 (44.5) | 256 |

**Table 3:** Correlation between use of contraceptives and newborn sex.

| Gravida | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| 1 | 76 (55.5) | 61 (44.5) | 137 |
| 2 | 43 (51.8) | 40 (48.2) | 83 |
| 3 | 21 (61.8) | 13 (38.2) | 34 |
| 4 | 4 (80.0) | 1 (20.0) | 5 |
| 5 | 1 (100.0) | 0 (.0) | 1 |
| Total | 145 (55.8) | 115 (44.2) | 260 |

**Table 4:** Gravida wise sex of newborn.

| First Usg Period | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| <3 months | 13 (39.4) | 20 (60.6) | 33 |
| 3-7 months | 127 (59.1) | 88 (40.9) | 215 |
| >7 months | 5 (41.7) | 7 (58.3) | 12 |
| Total | 145 (55.8) | 115 (44.2) | 260 |

**Table 5:** Month of first USG for all newborns.

| First Usg Month | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| < 3 month | 3 (25.0) | 9 (75.0) | 12 |
| 3-7 months | 71 (60.2) | 47 (39.8) | 118 |
| > 7 months | 1 (50.0) | 1 (50.0) | 2 |
| Total | 75 (56.8) | 57 (43.2) | 132 |

**Table 6:** Month of first USG and newborns amongst first pregnancy.

Of 137 mothers delivered in the first pregnancy, 5 underwent USG every month due to medical reasoning. Of remaining 132 mothers, 118

(89.4%) underwent USG during 3 to 7 months of pregnancy. The proportion of male babies born to those mothers was more than twice the proportion of male babies born to mothers who underwent USG before 3 months or after 7 months of pregnancy (Table 6). This proportion of male babies born to the mothers who underwent USG during 3-7 months was statistically noticeable ($\chi 2$=5.530, p=0.063).

Further, of these 132 mothers 84 (63.6%) mothers preferred to do USG in private hospitals, of which 49 (58.3%) mothers gave birth to male babies. However, of 118 mothers who did USG during 3-7 months of pregnancy, 74 (62.7%) mothers preferred to do USG in private hospitals. Of these 74 mothers, 46 (62.2%) mothers gave birth to male babies.

Of 132 mothers belonging to first gravida, 113 underwent USG for second time of which 70 (61.9%) did repeat USG during 3-7 months of pregnancy. This contained a greater percentage of male newborns compared to female newborns (Table 7). Further it was also found that 37 (52.9%) of these 70 mothers preferred to do USG in private hospitals and gave birth to 24 (64.9%) male babies. This has been found comparatively more for male babies (17(51.5%)) born to mothers who did USG in government or teaching institution hospital.

| Second Usg Period | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| 3-7 months | 41 (58.6) | 29 (41.4) | 70 |
| > 7 months | 24 (55.8) | 19 (44.2) | 43 |
| Total | 65 (57.5) | 48 (42.5) | 113 |

**Table 7:** Period of second USG and newborns during first pregnancy.

Cases with ANC taken in private hospital have greater proportion of male births compared to ANC taken elsewhere (Table 8).

| Anc Place | Newborn Sex | | |
|---|---|---|---|
| | Female (N%) | Male (N%) | Total |
| No ANC | 3 (75.0) | 1 (25.0) | 4 |
| Private | 56 (42.7) | 75 (57.3) | 131 |
| Govt/ KH | 52 (44.1) | 66 (55.9) | 118 |
| P/KH/Dai | 4 (57.1) | 3 (42.9) | 7 |
| Total | 115 (44.2) | 145 (55.8) | 260 |

**Table 8:** ANC place and newborns.

Proportion of males was always higher irrespective of previous issues. Mothers with past female issues have the highest proportion of males (68.1%). ($\chi^2$=4.390, p=0.222) (Table 9).

Out of all the mothers, 204 (78.5%) were not ready for tubectomy even after the birth of a male child. Amongst remaining the mothers ready for tubectomy were the ones who gave birth to a male newborn (42 (75%)), which is highly significant ($\chi 2$=10.701, p=0.001) (Table 10).

According to the 204 mothers, not ready for tubectomy, 110(53.9%) were the ones for whom gender of the child didn't matter and presently gave birth to a male child (54.5%) and a female child (45.5%). 8(0.03%)

of mothers wanted both a male and a female. However mothers with a strong wish for females after giving birth to a female were also not ready for tubectomy. Mothers with the opinion of an obligatory male were also not ready for tubectomy even after giving birth to a male child (50%) ($\chi 2$=7.390, p=0.117) (Table 11).

| Past Issue | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| No Issue | 81 (51.3) | 77 (48.7) | 158 |
| Male(s) | 27 (57.4) | 20 (42.6) | 47 |
| Female(s) | 32 (68.1) | 15 (31.9) | 47 |
| Both | 5 (62.5) | 3 (37.5) | 8 |
| Total | 145 (55.8) | 115 (44.2) | 260 |

**Table 9:** Past issue(s) and newborns.

| Tubectomy | Newborn sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| No | 103 (50.5) | 101 (49.5) | 204 |
| Yes | 42 (75.0) | 14 (25.0) | 56 |
| Total | 145 (55.8) | 115 (44.2) | 260 |

**Table 10:** Willingness of tubectomy and newborn sex.

| Mother Opinion | Newborn Sex | | |
|---|---|---|---|
| | Male N (%) | Female N (%) | Total |
| Male Compulsory | 38 (50.0) | 38 (50.0) | 76 |
| Anyone | 60 (54.5) | 50 (45.5) | 110 |
| Both Male & Female | 1 (12.5) | 7 (87.5) | 8 |
| Female | 4 (50.0) | 4 (50.0) | 8 |
| No Opinion | 0 (.0) | 2 (100.0) | 2 |
| Total | 103 (50.5) | 101 (49.5) | 204 |

**Table 11**: Opinion of mothers not ready for tubectomy regarding sex of newborn.

According to the opinion of other family members among the mothers not ready for tubectomy 48 (64.9%) were the ones who had given birth to a male child and for whom gender of the child did not matter (Table 12). However ones who had given birth to a female child and wanted a male child 67 (57.3%) had a strong preponderance for a male child, which is significant ($\chi^2$=10.992, p=0.027).

The mothers with gravida>1 and with previous male issues still gave birth to a male child 27 (57.4%) and the ones with previous female issues had a much greater proportion of male birth 32 (68.1%). The ones with past issues of both male and female child still have a higher proportion of male births 5 (62.5%) ($\chi^2$=11.800, p=0.008) (Table 13).

| Others opinion | Newborn sex | | |
|---|---|---|---|
| | **Male** N (%) | **Female** N (%) | Total |
| Male Compulsory | 50 (42.7) | 67 (57.3) | 117 |
| Anyone | 48 (64.9) | 26 (35.1) | 74 |
| 2 Male | 0 (.0) | 1 (100.0) | 1 |
| Both Male & Female | 1 (25.0) | 3 (75.0) | 4 |
| Female | 4 (50.0) | 4 (50.0) | 8 |
| Total | 103 (50.5) | 101 (49.5) | 204 |

**Table 12**: Opinion of family members of mother's not ready for tubectomy regarding sex of the newborn.

| Past issue | Newborn Sex | | |
|---|---|---|---|
| | **Male** N (%) | **Female** N (%) | **Total** |
| No Issue | 5 (23.8) | 16 (76.2) | 21 |
| Male(s) | 27 (57.4) | 20 (42.6) | 47 |
| Female(s) | 32 (68.1) | 15 (31.9) | 47 |
| Both | 5 (62.5) | 3 (37.5) | 8 |
| Total | 69 (56.1) | 54 (43.9) | 123 |

**Table 13:** Past issue(s) and newborns in mothers with gravida>1.

Among mothers with female newborns, all mothers with no past issues were not ready for tubectomy. Few mothers (40%) with previous male issues were ready for tubectomy but few (60%) still want more male births. However, mothers with both past and present female birth (93%) were not at all ready for permanent sterilization. Cases with both male and female issues in past and present female issues are also not ready for tubectomy 2(66.7%) ($\chi^2$=55.141, p<0.001) (Table 14).

| Past issue | Tubectomy | | |
|---|---|---|---|
| | **Yes N (%)** | **No N (%)** | **Total** |
| No Issue | 0 (.0) | 77 (100.0) | 77 |
| Male(s) | 12 (60.0) | 8 (40.0) | 20 |
| Female(s) | 1 (6.7) | 14 (93.3) | 15 |
| Both | 1 (33.3) | 2 (66.7) | 3 |
| Total | 14 (12.2) | 101 (87.8) | 115 |

**Table 14:** Tubectomy willingness among mothers with female newborns.

Among the male cases not ready for tubectomy, majority are the ones who had a strong desire for a male child and got it implying that they might want more male births (Table 15).

| Others opinion | Past Issues | | |
|---|---|---|---|
| | **Male** N (%) | **Female** N (%) | **Total** |
| Male Compulsory | 41 (93.2) | 3 (6.8) | 44 |
| Anyone | 36 (92.3) | 3 (7.7) | 39 |
| Both Male & Female | 0 (0) | 1 (100) | 1 |
| Female | 3 (75) | 1 (25) | 4 |
| **Total** | 80 (90.9) | 8 (9.1) | 88 |

**Table 15:** Opinion of other family members on having at least one son-cases with present male issues and not ready for tubectomy.

Secondly , people wishing for any child also didn't undergo tubectomy after birth of a male probably because either they want more males or they want a female which is highly significant (c=11.592 p=.009) (Table 16)

| Past issue | Newborn Sex | | |
|---|---|---|---|
| | **Female** | **Male** | **Total** |
| No Issue | 76 (50.0%) | 76 (50.0%) | 152 |
| Male(s) | 15 (44.1%) | 19 (55.9%) | 34 |
| Female(s) | 12 (31.6%) | 26 (68.4%) | 38 |
| Both | 2 (33.3%) | 4 (66.7%) | 6 |
| Total | 105 (45.7%) | 125 (54.3%) | 230 |

**Table 16:** Past issues of mothers not using contraceptives and their newborns.

Among the mothers not using temporary method of sterilization, in mothers where there was previous female issue, proportion of newborn male issue was more than twice compared to newborn female issues amongst the same ($\chi^2$=4.591, p=0.204).

## Logistic regression analysis

Stepwise logistic regression analysis was carried out by taking father's age, number of married years, birth order of newborn, newborn birth spacing, past issues, gravid, month of first USG as independent variables and sex of newborn as dependent variable.

Since proportion of male newborns was higher than female newborns, male was coded by '1' and female was coded by '0'. Stepwise logistic regression analysis revealed final model in step 6 with two independent variables- number of married years and month of first USG. This model predicted 91.7% male births and 20.9% female births correctly. The overall predictive ability of this model was 60.4%. However model with all above mentioned independent variables predicted 89.7% male births and 30.4% female births with 63.5% overall predictability. But the model in step 4 (Table 17) has also same predictability (Table 18).

| | B | S.E. | Significance | Relative risk | 95% C.I for RR | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Married yrs | 0.156 | 0.072 | 0.031 | 1.169 | 1.014 | 1.346 |
| **Past issues** | | | | | | |
| None | - | - | 0.22 | - | - | - |
| Male(s) | 1.021 | 0.636 | 0.108 | 2.776 | 0.798 | 9.661 |
| Female(s) | 1.36 | 0.655 | 0.038 | 3.895 | 1.078 | 14.07 |
| Both | 0.744 | 1.029 | 0.47 | 2.103 | 0.28 | 15.818 |
| **Gravida** | | | | | | |
| 1 | | | 0.137 | | | |
| 2 | -1.477 | 0.579 | 0.011 | 0.228 | 0.073 | 0.711 |
| 3 | -1.418 | 0.715 | 0.047 | 0.242 | 0.06 | 0.983 |
| 4 | -0.079 | 1.417 | 0.955 | 0.924 | 0.058 | 14.838 |
| 5 | 18.974 | - | 1 | 1.74E+08 | 0 | - |
| **USG** | | | | | | |
| <3 M | - | - | 0.067 | - | - | - |
| 3-7 M | 0.877 | 0.437 | 0.045 | 2.403 | 1.02 | 5.663 |
| >7 M | 0.055 | 0.746 | 0.942 | 1.056 | 0.245 | 4.554 |
| **Constant** | -0.845 | 0.483 | 0.08 | 0.43 | - | - |

**Table 17:** Logistic regression model determining significant variables associated with male births.

| Observed Newborn Sex | Predicted | | |
|---|---|---|---|
| | Newborn Sex | | |
| | Female | Male | Percentage Correct |
| Female | 35 | 80 | 30.4 |
| Male | 15 | 130 | 89.7 |
| **Overall %** | - | - | 63.5 |

**Table 18:** Predictive ability of logistic regression model.

Table 17 reveals that number of married years, females as past issues, gravid two as well as three, first USG between 3 to 7 months are found to be significantly associated with male births.

## Discussion

In India preference for a son is very strong and pervasive and has been frequently cited as one of the major obstacles in reducing the national fertility rate. This is being manifested in the form of declining sex ratios (ratio of females to males as per Indian context) at birth i.e. no of males born are more compared to females. Where ideal sex ratio (males/females) should be 1.07, India has the present sex ratio at birth being 1.12. For India, a reference ratio between 1.059-1.066 is used

[23]. Considering the declining sex ratio, a study was conducted to find the determinants associated with sex at birth in Krishna institute of medical sciences, karad, Maharashtra for a period of two months and 260 mothers and their relatives along with their newborns were interviewed and reasons for this declining sex ratio were tried to find out.

Out of these 260 newborns, 145 (55.80%) were males and 115 (44.2%) were females. The sex ratio was 1.26 that signifies a greater incidence of male child compared to female. Majority mothers (53.4%) wanted a newborn of any sex, while 36.5% of mothers wanted a son. However only 4% mothers wanted a female child & another 4% considered two to be the ideal number of children with gender composition of children being one son & one daughter. About 0.1% of mothers gave no opinion. In west Bengal, 62.8% mothers considered one male and one female to be the ideal gender composition, 32.7% of mothers wanted more sons & only 3.8% wanted more daughters [7]. Very high proportion regarding opinion of ideal gender composition in mothers of west Bengal than present study may be due to cultural differences.

Of 123 mothers with Gravida more than one, 56.1% gave birth to a male and only 43.9% gave birth to females signifying a greater demand of a male child compared to female. No gender discrimination was found among mothers with problem of sterility. As per study in west Bengal, mothers with only daughter, desired for another child and that should be a male. Whereas out of mothers with only one son, 8.7%

didn't want another child and 43.5% desired another son while 47.8% wanted a daughter [7]. In NFHS study, 47% women wanted next child to be a boy compared to only 11% of those who want next child to be girl. However for 42% of mothers gender of child didn't matter [10].

With successive birth orders the proportion of male newborn goes on increasing. Also at each birth order, proportion of male newborns is higher than proportion of female newborns. Male newborns up to second birth order and after that, 54.3% and 64.1% respectively revealed that after second birth order there was high proportion of male newborns. In west Bengal study, although at primiparity & second parity, the effect was minimal since women were still actively involved in process of family building but beyond parity two additional fertility was more closely associated with the surviving number of sons [7].

The ratio of males to females for second and third order births, conditional preponderance depending on the previous birth being female, is extremely high. 11% of total missing women (number of girls who have died due to discriminatory parental preferences) occur before birth [23].

In a study in Himachal Pradesh, it was found that at parity two, not a single woman with two daughters desired to terminate child bearing, while an overwhelming majority (86.5%) of women with one son and all women with two sons didn't want another child. Even at parity four and above, women who had no living sons didn't want to terminate child bearing [11].

High mean birth spacing amongst male newborns was 2.5 years with standard deviation 1.96 years as compared to female newborns may be as, at each parity, contraceptive acceptance was higher among women who had one or more living sons.

The proportion of male births increases with number of prior births and shorter birth intervals and decreases with parental age and proportion of multiple births [24].

In case of mothers with two children, only 15.4% of mothers with two daughters had undergone sterilization, while 84.6% of mothers with two sons are using contraceptives. Disincluding the sterility cases, it was found that majority cases giving birth to a male child (65.4%) had adopted temporary methods of sterilization. The percentage of women using a contraceptive method increased with increase in the number of living sons irrespective of number of living children [7].

According to relatives of mothers with male new borns and not ready for tubectomy, 50% were the ones who wanted males and 44.32% mothers were the ones for whom gender of child did not matter gave birth to a male child signifying that they either want more males or they desire for another female. The sex ratio in the second child was significantly lower if the first child was a girl [16].

High proportion of male births to those who preferred doing ultrasonography during 3-7 months i.e. 12-28 weeks of pregnancy in private hospitals signifies antenatal sex determination and sex selective abortions after antenatal sex determination. This increasing availability of ultrasound has been linked to the sharp rise in ratio of male births to female births. Prenatal sex selection with ultrasound followed by second trimester abortion is one of the ways sex selection manifests itself [24].

Advertisements for sex determination tests such as "invest only Rs 500 now and save your precious Rs 50,000 later" remind parents of the future expenses that a daughter would bring [20] and provokes them to go for sex determination and abort a female fetus based on prenatal ultrasound [25].

In India prenatal sex determination relies mostly on ultrasonography and is reliable after 14-16 weeks of gestation. The numbers of abortions that take place in India are poorly known. Especially because many terminations take place outside registered centers and are performed by uncertified providers. Estimates vary from 13-21 per 1000 births, based on large scale surveys and state statistics, while micro level studies may provide lower estimates [9].

With early abortion after sex determination, couples could conceal their pregnancy and implement their sex determination strategy, with little scrutiny from community. A ratio favorable to boys and adverse to girls coincides with introduction of modern prenatal sex determination methods. For first births, sex ratio at birth appears close to its normal values as most families do not shun the birth of an initial daughter. Also births that follow the birth of a son may not be greatly influenced by sex selection. It is only in later pregnancies among sonless couples that SRB values tend to surge [9]. The further male births are followed by one or more abortion attempts.

Parents wish to avoid the "worst case" scenario i.e. a family without a son. This is reflected in the sex ratio of higher parity births. While proportion of these amount to less than a quarter of pregnancies , among these the SRB may jump to values of 130 or more, roughly indicating an excess of 25 male births out of total of 230 [9].

The pressure to have a son is often felt most intensively by young wives who want to please their in laws. The sex ratio at birth is close to normal for first order births but rose steeply for second order births especially in rural areas where it reached 146 (143 to 149). Sex selective abortion accounts for almost all the excess males [26].

Proportion of males was higher irrespective of the area being rural or urban. In a study conducted in Orissa , it was found that in urban areas the sex ratio is more male oriented as urban women prefer sex determination as the facilities are available in urban health centers and urban women are under a constant stress to reduce the family size compared to their rural counterparts [12].

It is noticed that fewer women are born in urban areas than in rural areas [22]. Researchers have seen that higher sex ratio is observed in urban India compared to country's villages.

Obsession for son is prevalent in all income groups and education groups. However according to other researchers, child sex ratio was found to be inversely related to female literacy rate [17]. The odds of having a male infant increased with income quartiles. Highly educated heads of females had high odds of having a male infant than those with no formal education however it was not found to be associated with educational attainment of spouse [18]. Thus the gap between boys and girls is accelerating especially among wealthier and better educated [19]. Educated women tend to have fewer children than less educated women and in the context of strong son preference culture, the lower levels of fertility lead to greater pressure on couples to have boys instead of girls [21]. Lack of education prevents people to make use of sex selective abortion technology. Fewer female births occur in areas with scarce independent income opportunities for females [22]. Son preference among lower income groups is usually less acute than rest of society.

While the mothers and other family members of newborn were being interviewed, direct questions regarding reasons for son preference were asked. Reasons as given by them were that sons help in

continuation of family lineage, perform certain religious and social functions, perform the last rites and sons are expected to provide financial, emotional and social support at old age [15] as married daughters are not supposed to contribute to their parent's expense after marriage. Boys inherit their parent's property and carry on their family name. Due to patrilineal system, sons have a prominent role and add prestige to the status and are a source of pride for their parents9. Also males can perform hard tasks like ploughing fields and work for longer hours at a stretch compared to women. Among other reasons were, absence of any males in family, handicapped father, no income source in family, no forerunner of large property of parents, mentality of society, age old thoughts, female child needs a brother to play with, please in laws, follow age old traditions, sick siblings, fear of mother in law, to compete with mother in law and sister in law in the number of sons, to have status in society. Also parents feel that they can excise their rights over males as they live with them forever unlike daughters who have to leave home one day and are rightly described as "parayadhan".

A view disfavoring a female child is basically her marriage. Once the daughter marries, she leaves the parental home to live with her in-laws so she is of little economic benefit to her parents and will not be able to support them in old age. Daughter's wedding is a financial drain for parents due to dowry, customary gifts, wedding expenses, post marriage expenses which include financial help during first pregnancy, additional dowry. Dowry forms a major bulk of marriage expenses and can exceed several years of household income.

People believe that having a girl is like "watering your neighbor's garden". In general people think about costs related to girls and benefits related to boys and resort to sex determination practices.

As a matter of surprise cases were also found where the preference for females had exceeded the males. Reasons being contagious marriages as they help to understand the family better and gradually the fear related to birth of a female child is eliminated. Other reasons were no females in family, excessive number of males in family. These families considered that daughters were kinder, considerate, helpful, genuine, loving tender and provide support to their parents under all circumstances giving better care to her parents in old age when sons tend to fight and leave their parents alone. Highly educated mothers with good financial background were also in favour of daughters. People also believed that a child is "god's gift" and should be handled with care and accepted with due respect. A denial to this gods wish will curse them throughout life.

Usually mothers with no gender discrimination, majority were the ones who had been sterile for a pretty long time and had conceived now or had faced a lot of problems during pregnancy or the ones who believed in a small family norm i.e. a small family happy family with full regards and acceptance to females also [27].

## Conclusion

The sex ratio imbalance in India is acute indicating sex-selection by parents, whereby parents might choose to abort female fetuses following second trimester abortions based on prenatal ultrasounds. The combination of new technologies for prenatal sex determination and abortion has proved to be a dramatic cocktail which has become an efficient sex selection device. The sex ratio is extremely male biased. The sex ratio in second children if the first was a girl is even higher. Mothers were not found to be ready for permanent means of sterilization unless they had one or two sons. The active reproductive

period is also greater in families with greater preponderance for a male child. Culture is intricately linked with the economic reality of each couples life, so that there are financial and psychological repercussions to parents who have no sons.

Thus it was concluded that it is the society and old age thoughts which force the families to prefer a male offspring.

## Summary

One of the most significant features of the twentieth century is the dramatic decline in fertility and explicit preference for smaller families in most parts of India. The present study was undertaken to find determinants responsible for this declining sex ratio.

The study was conducted in Krishna Hospital and medical research Centre, Karad of western Maharashtra, a teaching hospital. All the live newborns, their mothers and care taking relatives, in the Department of Obstetrics and Gynecology were included the study.

There were 260 deliveries during period of two months. Out of these, 145 (55.8%) were males and 115 (44.2%) were females. Mothers age for both male and female births holds no significant difference (t=0.950, p=0.343), however, fathers age is found to be comparatively greater for males compared to females (t=1.679 p=0.094). Years since marriage among parents of male newborns was significantly more than parents of female newborns (t=2.608 p=0.010). At each birth order proportion of male newborns was higher than proportion of female newborns. The proportion of male babies born to the mothers who underwent USG during 3-7 months was statistically noticeable ($\chi^2$=0.530, p=0.063). Cases with ANC taken in private hospital have greater proportion of male births compared to ANC taken elsewhere.

Logistic regression analysis predicted 91.7% male births and 20.9% female births with two independent variables i.e. number of married years and month of first USG. The overall predictability was 60.4%.

However independent variables like father's age, number of married years, birth order of newborn, newborn birth spacing, past issues, gravida and month of first USG predicted 89.7% male births and 30.4% female births with 63.5% overall predictability.

It was summarized that it is the society and old age thoughts, which force the families to prefer a male offspring.

## Recommendations

- General population should be educatedaboutthe importance ofdeclining sex ratio.
- General beliefs, social taboos and superstitions about female child should be overcome and equal importance should be given to both males and females.
- Rules regarding USG for sex determination should be followed strictly.
- Permanent methods of contraception after two child births should be mandatory to avoid the problem of repeated births to get a male child.
- Incentives should be given to parents completing their family with two female child births.

## References

1. Audio visual review (1991) Born female. Produced by UNICEF Regional office for south central Asia. Govt. of India. Indian J Soc work 52: 115-117.

2. Sex ratio in Demography and planning (2007) Parks textbook of preventive and social medicine. Banarsidas Bhanot publishers 382

3. List of sex ratio by country/region (2006) CIA World Fact book.

4. Population Foundation of India (2006) Factors responsible for female foeticide and implications of declining child sex ratio.

5. Sex ratio in Demography and planning (2009) Parks textbook of preventive and social medicine. Bhanot publishers 415.

6. Wei Xing Zhu, Li Lu (2009) Therese Hesketh. China's Excess Males, Sex Selective Abortion, and One Child Policy: Analysis of Data from 2005 National Intercensus Survey. British Medical Journal 338: b1211.

7. Indira Dey, RamendraKarayaChaudhari (2009) Gender preference and its implications on reproductive behaviour of mothers in a rural area of west Bengal. Indian journal of community medicine 34: 65-67.

8. S Bandyopadhyay, AJ Singh (2007) Sex selection through traditional drugs in rural north India. Indian journal of community medicine 32: 32-34.

9. Christophe Z Guilmoto (2007) Characteristics of sex ratio imbalance in India and female scenario.

10. International Institute of Population Sciences (1999) National family health survey 1999: 111-120.

11. Malahi P, Raina G (1999) Preferences for the gender of children and its implications for the reproductive behaviour in urban Himachal Pradesh. J fam welfare 45: 23-30.

12. KanakaLata Devi (2003) Causes of declining sex ratio in Orissa – an analysis.Journal of family welfare 49: 43-49.

13. Kanitkar T, Murthy BN (1984) Factors associated with infant mortality in Rajasthan and Orissa. Paper presented at conference on determinants of infant mortality in India – Gujarat institute of area planning, Ahmedabad

14. AditiTandon (2008) Coming: new deal for the girl child incentive: cash, insurance. The Tribune online edition Chandigarh, India.

15. Arun K Aggarwal, Neeru Gupta (2007) Gender Issues: why I was not born as a son? Indian journal of community medicine32: 173-174.

16. MohitSahni, NeerajVerma (2008) Missing girls in India: infanticide, foeticide and made to order pregnancies? Insight from hospital-based sex ratio at birth over the last century.

17. Chakraborty, Lekha, Sinha, Darshy (2006) Determinants of declining sex ratio in India: an empirical investigation.

18. Social analysis of sex ratio (2009) Journal of epidemiology and community health. 63: 245-252

19. Australasian Bioethics Information (2003) sex ratio continues to slide. 98: 1446-2117.

20. Population reference bureau (2004)Sex ratio at birth begins to improve in India.

21. Anil B Deolikar (2009) India's falling juvenile sex ratio.

22. Rebeca A Echávarri (2006)Gender bias in sex ratio at birth: the case of India.

23. Swan Anderson, Debra Ray (2008) Missing Women: Age And Disease.

24. BelaGantra (2008) Maintaining Access to safe abortion and reducing Sex Ratio imbalances in Asia Reproductive Health. Matters 16: 90-98.

25. Emily Oster (2008) Proximate sources of population sex imbalance in India. University of Chicago and NBER.

26. The wall street journal- lounge (2009) . A skewed demographic shift.

27. Mikhail Lipatov, Shuzhuo Li, Marcus W Feldman (2008) Economics, cultural transmission, and the dynamics of the sex ratio at birth in China.