Sex-specific Trends in Under-five Mortality in Rural Ballabgarh

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Objectives: To assess sex-specific differentials in child survival from 1992-2011. **Methods:** We analyzed data from the electronic database of Health and Demographic Surveillance System (HDSS) site in Ballabgarh in North India. **Results:** Sex ratio at birth was adverse for girls throughout the study period (821 to 866 girls per 1,000 boys) and was lowest in the period 2004-2006 at 821 girls per 1,000 boys. Overall, under-five mortality rates during the period 1992-2011 remained stagnant due to increasing neonatal mortality rate (9.2 to 27.7 *P*< 0.001). Mortality rates among girls were consistently and significantly higher than boys during the post-neonatal period (160% to 200% higher) as well as in childhood (160% to 230% higher). **Conclusions:** Strategies to address the neonatal mortality and gender differences are required for further reductions in child mortality in India.

Keywords: *Gender discrimination, Infant mortality, Neonatal mortality.*

Reducing child mortality and gender disparities are among the keystones for achieving Millennium Development Goals (MDGs) as enunciated by United Nations [1]. India has achieved considerable success in reducing under-five mortality, although it is still a long way from the MDG target of in 2015 [2]. Most efforts to reduce childhood mortality in developing countries have focused on the causes of post-neonatal mortality. Female disadvantage in sex ratio at birth and higher mortality rates among girls; however, present further challenges to child health in India [3].

The Ballabgarh Health and Demographic Surveillance System (HDSS) site had earlier reported trends in infant mortality from 1972 to 1997 but did not focus on sex differentials in mortality, since gender discrimination was not yet identified at that time as a major determinant of mortality [4]. However in 2004, the site published data on sex ratio at birth from 1991 to 2002 [5]. This paper uses the Ballabgarh HDSS data for subsequent years to assess the progress made since then. The objectives were to estimate the overall and sex specific trends for mortality in different age groups during childhood including sex ratio at birth.

METHODS

The study area of Ballabgarh HDSS comprises of 28 villages, which are under demographic surveillance (a population of 85,795 in 2009). The details of the study area

have been described prevously [6]. All routine information collected is updated once a month in a computerised management information system (MIS) at Ballabgarh. The full details of the MIS and its quality control procedures have been described elsewhere [7].

Based on the dates of birth and death in the database, deaths were classified as neonatal (up to and including 28 days), post-neonatal (29 to 365 days) or childhood (1 year to 4 years). The data for eighteen years was divided into six three-year periods.

The significance of differences in mortality rates between boys and girls in each of the three-year periods was tested using chi-squared tests after Bonferroni correction for multiple comparisons. We used three-year moving averages to plot curve but used individual year data to measure the slopes of trends in mortality rate and their significance using linear regression with year as predictor variable and crude mortality rate as dependent variable. All the analyses were conducted using STATA 10. The sex ratio presented is defined as the number of female births per 1,000 male births. The study protocol was cleared by the Institutional Ethics Committee of AIIMS. Only secondary data without personal identifiers were used for analysis in this study.

RESULTS

A total of 41,678 live births (22,597 boys) were recorded in the study area from 1992 to 2011. Sex ratio at birth was

TABLE I NUMBER OF BIRTHS AND SEX RATIO AT BIRTH IN RURAL BALLABGARH FROM 1992 TO 2011

Year	Total population in the second year	Female	Total	Sex Ratio
1992-94	68260	3,032	6,532	866.3
1995-97	72995	2,948	6,412	851.0
1998-00	76138	2,875	6,303	838.7
2001-03	79697	2,858	6,213	851.9
2004-06	82612	2,720	6,034	820.8
2007-09	85795	2,733	5,991	838.9
2010-11	89996	1,915	4,193	840.6

adverse for girls throughout the study period (821 to 866 girls per 1,000 boys) (***Table* I**). It was lowest in the period 2004-2006 at 821 girls per 1,000 boys.

Neonatal mortality rate increased three-fold during the study period and this was true for both boys and girls (***Web Table* I**). The rate increased by 1.13 per 1,000 live births annually during 1992-2011 ($P<0.001$). The proportion of IMR contributed by neonatal mortality doubled from 24.2% in 1992-94 to 53% in 2010-11. As a proportion of all under-5 mortality, it ranged from 15% in 1992-94 to 42% in 2007-09. The increase in neonatal mortality was mainly due to early neonatal deaths (<7 days) in both sexes, especially since 1998 (data not shown). Post-neonatal mortality rates declined slightly ($P>0.05$) during the study period (from 28.8 to 24.6 per 1,000 live births) and the decline was similar in both sexes (***Web Table* I**). Girls experienced significantly higher mortality at this age during 1995-2003 (160% to 200% higher). Post-neonatal mortality accounted for between 37% and 47% of total under-5 mortality over time. Childhood mortality rates showed a significant decline during the study period (***Web Table* I**). The decline was sharper for girls (from 33.3 to 16.7, $P<0.002$) as compared to boys (from 16.0 to 10.5, $P<0.02$)

Infant mortality rates increased significantly ($P<0.002$) during this period. The increase was roughly equal for both sexes. While there was a consistently higher mortality among females (115% to 166%), this was significant only for three time periods (1995-97, 2001-03, 2004-06). Under-5 mortality rates during the period 1992-2009 remained more or less stagnant ($P>0.05$) in the population. This was due to rising neonatal mortality rates and decreasing childhood mortality rates and post-neonatal mortality rates. For boys there was a slight but not significant increase in mortality rates during this period (from 50.9 in 1992-94 to 61.6 per 1000 in 2009-11).

Throughout this period, females had significantly higher under-five mortality rates, which ranged from 122% to 180% of the rate for boys. During 2004-2006, the effects of discrimination against girls peaked.

DISCUSSION

Using data from a population under longitudinal demographic surveillance in a rural area of Northern India, we show that sex differentials in mortality and an increase in neonatal mortality during the study period present major barriers for further reduction in infant mortality in Ballabgarh. In the study area, even during the early neonatal period, mortality rate was skewed unfavourably for girls in three of the six three year periods. This probably indicates more active discrimination against girls. We have earlier reported that significantly excess deaths in girls are due to low birth weight, diarrhoea and malnutrition [8]. Another study among neonates showed that even though the overall rate of perceived illness was similar in males and females, parents preferred better health-care facilities, and spent more on boys [9].

The increase in neonatal mortality in the study area cannot be completely explained. During the study period at Ballabgarh HDSS, the stillbirth rate remained fairly constant at about 2% but the reported abortion rate increased from about 3% in the earlier years to about 8% in the later years, probably due to earlier registration of pregnancies and therefore subsequent abortions. Despite an increase in institutional delivery from around 20% in mid-nineties to about 60% in 2009 neonatal mortality rates have not come down. Our initial surveys have shown that many of these facilities do not have essential equipment (for resuscitation, temperature maintenance) and are assisted by people with inadequate skills for conducting delivery. Except for the change in recent times in the study area in neonatal mortality, a higher mortality among females at roughly the same magnitude has been reported since mid-sixties when this project started [14].

The "One million death" study, based on a national cluster sample in India, in 2005 reported a lower neonatal mortality among girls (85% of boys) and a higher mortality among girls in the 1-59 months age group (135% of boys). However, the actual mortality rates were higher than this study area [17]. The National Family Health Survey (NFHS) data from all the three rounds covering events of a time period between 1988 to 2005, as well as Sample Registration System (SRS) data from 1971 to 2008, confirm a slightly lower neonatal mortality among girls in rural India (85% to 95%) and higher mortality rates for girls after that age group [10,11].

WHAT THIS STUDY ADDS?

- In addition to the continued higher girl child mortality in 1-4 year period, there is evidence of a worsening gender differential in terms of sex ratio at birth and higher mortality even in neonatal period.

- Despite increase in institutional deliveries, there has been no concomitant decrease in neonatal mortality in the study population.

The data for the study were retrieved from computerized HMIS of Ballabgarh HDSS which has maintained a longitudinal record of all individuals residing in Ballabgarh HDSS since 1992. The regular liaison with other community based workers, provision of health care by the same set of workers, antenatal tracking ensure high validity of the data collected. The study population is not necessarily representative of the rest of the country and the experiences shared here may not mirror the changes in the rest of the country. The issues raised in our study are applicable to other parts of north and western India, which are socio-demographically and culturally similar to Ballabgarh HDSS. Sex-differential mortality occurs to some extent throughout the country and our findings may be similar or attenuated in other settings. However, many factors like high antenatal care and immunisation coverage in the study area might have blunted any sex differentials arising out of differential coverage due to these programmes. Overall high gender bias existed in other states also [14,15].

In conclusion, increasing neonatal mortality and sustained excess mortality among girl children before and after birth point to the need for new strategies for further reduction of child mortality in Ballabgarh and rest of Northern India. A much more vigorous social mobilization campaign on girl child using ASHAs during Village Health and Nutrition Days and universalizing access to free care for childhood illnesses are imperative to make sufficient progress so as to achieve MDG4.

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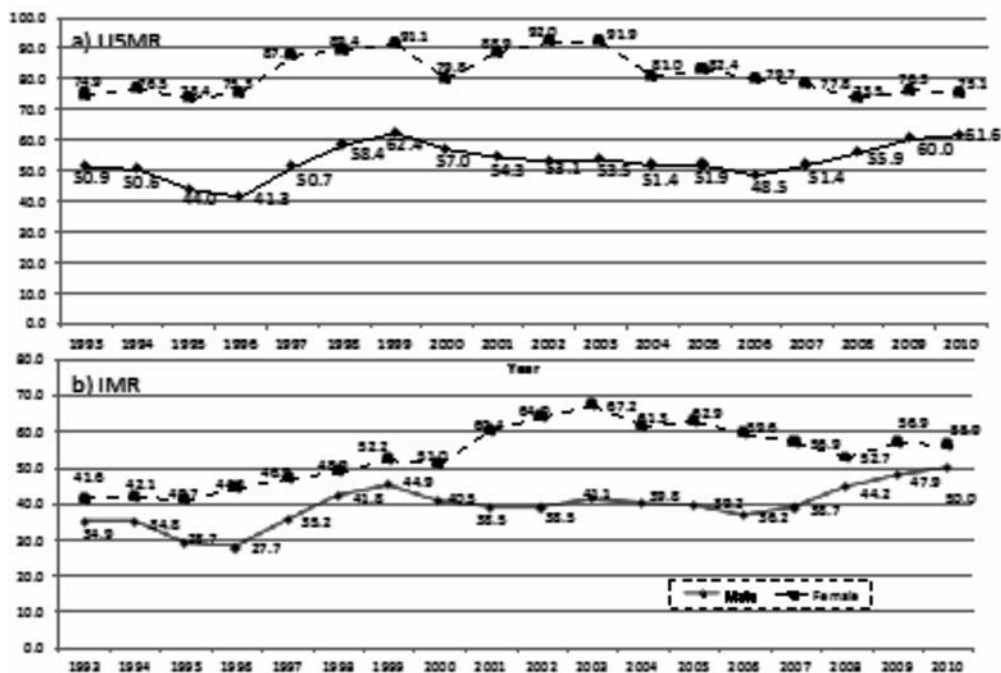
FIG.1 *Trends in under-five (US MR) and infant mortality rate (IMR) in rural Ballabgarh 1992-2010.*

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