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Where girls are less likely to be fully vaccinated than boys: Evidence from a rural area in Bangladesh

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ABSTRACT

Background: Immunization is one of the most successful and effective health intervention to reduce vaccine preventable diseases for children. Recently, Bangladesh has made huge progress in immunization coverage. In this study, we compared the recent immunization coverage between boys and girls in a rural area of Bangladesh.

Setting: The study is based on data from Chakaria Health and Demographic Surveillance System (HDSS) of icddr,b, which covers a population of 90,000 individuals living in 16,000 households in 49 villages.

Methods: We calculated the coverage of fully immunized children (FIC) for 4584 children aged 12–23 months of age between January 9, 2012 and January 19, 2016. We analyzed immunization coverage using crude FIC coverage ratio (FCR) and adjusted FCR (aFCR) from binary regression models. The dynamic of gender inequality was examined across sociodemographic and economic conditions.

Main outcome measure: The adjusted female/male (F/M) FIC coverage ratios in various sociodemographic and economic categories.

Results: Among children who lived below the lower poverty line, the F/M aFCR was 0.89 (0.84–0.94) compared to 0.98 (0.95–1.00) for children from the households above lower poverty line (p = 0.003, test for interaction). For children of mothers with no high school education, the F/M aFCR was 0.94 (0.91–0.97), whereas it was 1.00 (0.96–1.04) for children of mothers who attended high school (p = 0.04, test for interaction). The F/M aFCR was 1.01 (0.96–1.06) for first born children but 0.95 (0.93–0.98) for second or higher birth order children (p = 0.04, test for interaction).

Conclusions: Fewer girls than boys were completely vaccinated by their first birthday due to girls' lower coverage for measles vaccine. The tendency was most marked for children living below the poverty line, for children whose mothers did not attend high school, and for children of birth order two or higher. In the study setting and similar areas, sex differentials in coverage should be taken into account in ongoing immunization programmes.

1. Introduction

In recent years, ten countries including Afghanistan, Bahrain, Bangladesh, China, Egypt, India, Iran, Jordan, Nepal, and Pakistan have had higher than expected under-5 female mortality [1,2]. Excess female deaths have also been reported in several studies from the Indian subcontinent and the reasons attributed to differential treatment of girls compared to boys [3]. Neglect of girls with respect to utilization of health care services has been reported in many studies since 1980 [4], and the current global health paradigm emphasizes equity and gender equality [5].

During the last two decades Bangladesh has achieved a tremendous progress in reduction of under-5 mortality [6] and the female advantage in child survival has increased [7]. Successful immunization programmes may be one of the key driving forces for improving child health, especially among females [8]. However, lower immunization coverage among female children has also been reported in several studies in Bangladesh [9].

The effects of sociocultural factors on gender-bias immunization coverage has rarely been examined. This article assesses the gender-gap in immunization coverage according to

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sociodemographic and economic conditions of children in Chakaria, a rural sub-district of Bangladesh.

2. Materials and methods

2.1. Settings and population

International Center for Diarrheal Diseases Research, Bangladesh (icddr,b) runs a Health and Demographic Surveillance System (HDSS) in Chakaria. The HDSS covers a population of 90,000 individuals living in 16,000 households in 49 villages. All households are visited every three months to enquire about marriages, pregnancies, births, migrations, and deaths. For this study, information on vital events and vaccinations of children below 3 years of age was collected during trimonthly household visits.

The Expanded Programme on Immunization (EPI) provides services in the HDSS areas through 95 EPI outreach centers. Vaccines are given as recommended by World Health Organization (WHO): BCG (Bacillus Calmette–Guérin) at birth, Penta (diphtheria-tetanus-pertussis-hepatitis B-Haemophilus influenzae type b) and OPV (oral polio vaccine) in 3 doses at 6, 10, and 14 weeks of age, followed by measles vaccine (MV) at 9 months. It should be noted that providing vitamin A supplementation (VAS) with MV was stopped in September 2012.

2.2. Definitions of variables

2.2.1. Poverty level

A wealth index was calculated using principal component analysis from household assets [10]. The lowest 18 per cent of households were chosen as a cutoff for the lower poverty line as defined by the *Bangladesh Bureau of Statistics* [11] and households were categorized as below and above the lower poverty line. Households below this lower poverty line are likely to suffer hardships.

2.2.2. Distance to EPI outreach centre and town

We calculated the distance from the child's home to EPI outreach centres and to Upazila Health Complex (UHC) using GPS (global positioning system) coordinates. We had calculated the distance between the child's home to all 95 EPI outreach centres in the HDSS area and the minimum distance was defined as the *distance to EPI outreach centre*. The UHC located in Chakaria sub-district town supplies vaccines to EPI outreach centres, and the distance between the child's home and the UHC was defined as *distance to town*.

2.3. Main outcome: Fully immunized children (FIC)

Among children aged 12–23 months who were alive during household visits, those who were considered FIC are those who received BCG, three doses of Penta and OPV, and MV by 12 months of age. The FIC coverage was calculated by dividing the number of children who received the *eight vaccination doses* before 12 months of age by the number of children visited between 12 and 23 months of age whose vaccination card was seen at the visit. For children who had more than one visit, vaccination status was determined at the earliest visit at which the vaccination card was seen.

Children whose vaccination card had been lost and children whose vaccination card could not be viewed at the visit were excluded from the analysis. Moreover, vaccines given during campaigns (e.g. OPV and MV) were not included in calculation of the FIC coverage because they are not part of the routine programme and are not recorded on the vaccination card. Likewise, maternal recall of routine vaccinations was not used since the information would not allow us to ascertain whether the vaccinations were delivered before 12 months of age. Therefore, only vaccines noted in the vaccination card for routine vaccinations were used for the present analysis.

2.4. Statistical methods

The Kaplan-Meier method was used to draw vaccination coverage curves. To test potential sex-differences in median age of vaccination, we used a Mann-Whitney test. Pearson's chi square test was performed to examine the distribution of children and the coverage of FIC according to background characteristics. We analyzed immunization coverage using crude FIC coverage ratio (FCR) and adjusted FCR (aFCR) with generalized linear models from the binomial family using the "binreg" command in STATA software. We included sex, parity, parental education, father's occupation, poverty level, distance to EPI outreach centre and town, antenatal care visit, place of birth, and village as potential confounders in the adjusted models. To assess the gender-gap in FIC coverage, interaction between sex and all background variables were examined in adjusted regression models.

Furthermore, to understand the dynamic of gender disparity in FIC coverage, we analyzed a subset of 545 children with same-sex sequences of siblings: second girl after girl (N = 282); second boy after boy (N = 263), and examined the interaction with poverty and maternal education in regression models.

3. Results

3.1. Study children

Between January 9, 2012 and January 19, 2016, health, demographic, and vaccination information of 5747 children aged 12–23 months was collected by surveillance workers (SWs). A total of 1163 children were excluded from the present study because a vaccination card was not seen (Fig. 1). The remaining 4584 children (2376 boys and 2208 girls) were included in the analysis. Background characteristics for boys and girls are shown in Table 1. There was no difference in background characteristics for boys and

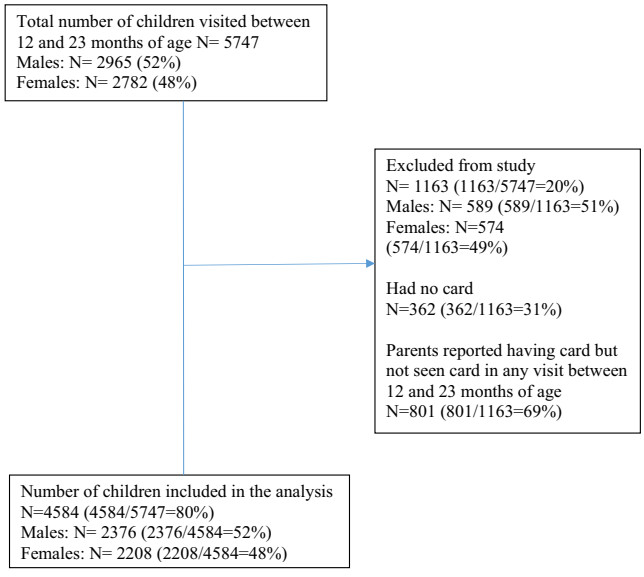

Fig. 1. Flow chart of study children.