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Induced abortion after advent of fetal sex detection technology and child sex at birth

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Abstract

Background National level Sex Ratio at Birth (SRB) is normal in Bangladesh despite its patriarchal social structures, strong son preference, and low fertility level, widely recognized as preconditions for Gender-Biased Sex Selection (GBSS). To better understand this anomaly, we examine the trend in SRB in a sub-district in Bangladesh and assess the impact of the introduction of fetal sex-detection technology and the history of induced abortion on child sex using longitudinal data.

Methods We have used secondary data collected routinely by icddr, b's Matlab Health and Demographic Surveillance System (HDSS) between 1982 and 2018. All births occurring during this period ($N = 206,390$) were included in the analyses. We calculated the SRB and used multivariate logistic regression analyses to assess the likelihood of birth of a male child before and after the introduction of ultrasonogram in Matlab.

Results Overall, SRB was within the natural limit (106) during 1982–2018 in Matlab. SRB among women with a history of induced abortion was 109.3 before the introduction of ultrasonography in 2001 and 113.5 – after 2001. Women's history of induced abortion prior to introduction of ultrasonogram (1982–2000) increased the likelihood of birth of a male child 1.06 times (AOR 1.06; 95% CI- 1.01–1.11). In the period after, however, this likelihood was 1.08 (AOR 1.08; 95% CI- 1.02–1.15).

Conclusions In a context with normal SRB, it was found to be skewed among women who had induced abortion. SRB was relatively more skewed among such women after the advent of ultrasonogram compared to a period without ultrasonogram. Moreover, induced abortion after introduction of fetal sex determination technology increased the likelihood of birth of a male child. These findings suggest the plausibility of GBSS in a sub-group. Further research is needed, particularly in regions with skewed SRB to examine whether GBSS is indeed a threat to Bangladesh.

Keywords Gender biased sex selection, Sex ratio at birth, Induced abortion, Fetal sex detection technology, Longitudinal data, Bangladesh

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Introduction

Gender-biased sex selection is a serious human rights violation and an urgent global health challenge. Gender-Biased Sex Selection (GBSS) is a key obstacle to achieve gender equality as aspired by the Sustainable Development Goals (SDGs). Adverse implications of GBSS including marriage squeeze, violent and antisocial behavior, have been well documented [1–5]. Gender-biased sex selection is widespread in several countries in Asia, characterized by high son preference and low fertility levels [1, 6]. Bangladesh, a neighbor to countries with high GBSS rates, presents an anomaly. The national level of Sex Ratio at Birth (SRB) is not skewed in Bangladesh [7] despite its patriarchal social structures with strong son preference, declining fertility, higher desired SRB (DSRB) than observed (OSRB), and availability of technology for sex determination of fetus – known as important preconditions for GBSS [1, 8]. This, however, is not sufficient for complacency as there is substantial geographic variation in SRB within Bangladesh and some divisions have SRB as high as 110 or greater [7]. In divisions with normal OSRB, the DSRB is still higher [7], which is recognized as a risk factor for GBSS [7, 9, 10].

The advent of technology for determining the sex of the fetus in Bangladesh is a concern for GBSS. Ultrasonography (USG), a technology used for prenatal sex detection was introduced only in a handful of tertiary government hospitals in the 1980s. After the 1990s, the technology gradually became available in district and *upazila* or sub-district levels. Since mobile USG services are not available in the country side, the rural people get access to it at the sub-district or district hospitals [11]. According to DPSDU [10], 90% of women reported the availability of USG technology in the vicinity, 40% reported undergoing USG during pregnancy, and 84% of the latter used it for sex determination [12]. Women with son preference were 1.53 times more likely to use USG [12]. Now, non-invasive prenatal testing, a technology capable of determining sex at a very early stage of gestation is still rare and expensive in Bangladesh [12].

For GBSS, sex determination of fetus needs to go hand in hand with methods of induced abortion. There exists both traditional and medical methods of abortion in Bangladesh. Since 1979, abortion is available to women in Bangladesh up to 12 weeks of gestation, if the pregnancy poses threat either to the fetus or the mother's health. This is known as Menstrual Regulation (MR). In 2014, the Government of Bangladesh approved the use of mifepristone–misoprostol up to 9 weeks from last menstrual period (LMP) to be administered by trained service providers [13]. Mifepristone and Misoprostol used for Menstrual Regulation with Medication (MRM) are available in the pharmacies all over Bangladesh. Regardless of official policy against over the counter sale these medicines are widely sold over the counter [14]. There has been no government directive prohibiting disclosure of fetal sex by healthcare providers. In 2020, the Supreme Court of Bangladesh issued a ruling asking the government to explain as to why they should not be directed to prohibit the gender detection of unborn babies, in order to ensure protection of the unborn and pregnant mothers [15].

Concerns have been raised regarding the reliability of SRB calculated in Bangladesh drawing on methodologically different data sources [7]. Some of these studies suffer from inadequate sample sizes [12]. The present study addresses these gaps in the literature using longitudinal data from Matlab Health and Demographic Surveillance System (HDSS) over a period between 1982 and 2018. We examine the trend in SRB in Matlab, assess SRB before and after the advent of ultrasonography, and then assess whether a combination of availability of fetal sex-detection technology and induced abortion impact child sex at birth in Matlab.

Methods

Study setting and study design

This study used secondary data, collected routinely as part of icddr, b's Matlab Health and Demographic Surveillance System (HDSS), in a predominantly rural sub-district. Matlab HDSS is the longest and largest HDSS in the developing world established and run by icddr, b since 1966 [16]. Currently, the HDSS covers around 240,000 people in 56,000 households in 142 villages. HDSS routinely collects data on vital events, i.e., birth, death, marriage, divorce, and migration. Since 1977, it also collects data on some selected child and reproductive health indicators. Data were collected monthly until 2006, and since 2007, the system switched to bi-monthly data collection. Data are collected by trained, locally recruited female Community Health Research Workers (CHRW). In addition to routine data collection periodic censuses are conducted to collect socio-economic information (e.g., education, occupation, NGO membership, income sources, food security, etc.) in Matlab in the years 1966, 1974, 1982, 1996, 2005, and 2014 [16]. In 2001, ultrasonography was introduced in Matlab.

Study sample

Upon consultation with the HDSS staff regarding the completeness and quality of the data, this study included all births, excluding the twins, occurring between 1982 and 2018 in 142 villages in HDSS making the total sample size 206,390. All observations with complete data from HDSS were included in the model. We matched these data with relevant background information from periodic censuses carried out in 1982, 1996, 2005, and 2014. To the extent possible, we have used information on background characteristics from the preceding census

for each birth. Wherever such data were not available, we used available data from the census closest to the birth considered.

Measurement

SRB in this paper has been defined as the number of male births per 100 female births. SRB with 103–106 males per 100 females has been considered natural [7, 8, 17]. Since ultrasonography was introduced in Matlab in 2001, we divided the whole study period into 1982–2000 and 2001–2018 to represent periods before and after the introduction of this technology. For trend analysis, we calculated three-year-averages of SRB including all births between 1982 and 2018. This strategy allowed us to have an adequate number of births at each time point. Birth order of the child was not asked during HDSS data collection. Since, HDSS did not have reliable data on childbirth for the period preceding 1982 (HDSS, personal communication) we have imputed birth order for 1982–1995 using multiple imputation method. Our decision to impute birth order up to 1995 was guided by our calculation of the average time to complete a family after marriage for a woman (13.1 years) based on Bangladesh Demographic and Health Survey (BDHS) 1996-97 data. Birth order for children for the period 1996–2018 was calculated based on births recorded between 1982 and 2018 and by adding the number of children women brought to Matlab in case of in-migration.

Outcome variable in the logistic regression analysis

To find out whether there exists any indication of GBSS, we have treated the sex of the child born as the outcome variable. We constructed a dummy variable, coding birth of a male child as 1 and the birth of a female child as 0.

Covariates

The covariates were selected based on the relevant literature, and available dataset and bivariate analysis. Mother's age at birth of the index child, mothers' education, religion, wealth quintiles, mother's history of induced abortion, and birth order of the child were used as covariates in the models. Mother's age at birth of the index child was categorized and coded as: ≤ 24 years (1), 25–29 years (2), and 30 and above years (3). Mothers' education was categorized as no education, primary, secondary- and higher and coded as 1, 2, and 3 respectively. Here, no education refers to participants who never attended formal school. Wealth quintiles were calculated based on principal component analysis of household assets. A dummy variable was introduced for religion, with Muslims coded as 1, and non-Muslims as 0. If the child was born during 1982–2000 and its mother had a history of induced abortion during the same period, it was coded as 1 and otherwise 0. The same strategy was followed for births occurring during 2001–2018. The birth order of the children was categorized and coded as: first (1), second (2), third-and higher (3).

Data analyses

Descriptive analysis was performed to explore background characteristics of the study participants. We conducted logistic regression for the whole period (1982–2018) as well as two logistic regression analyses separately for the two time periods, namely before the introduction of ultrasonography (1982–2000) and after the introduction of ultrasonography (2001–2018) to explore whether the likelihood of birth of a male child changed in Matlab after the introduction of ultrasonography compared to the preceding period. We analyzed the data using STATA 15.

Results

Background characteristics of the study sample

Table 1 shows the background characteristics of the study sample during 1982–2000 and 2001–2018. The women during the period 1982–2000, had a higher proportion of third and higher birth order (52%) compared to first (20%) and second (28%) order births. In contrast, the proportion of first order births was slightly higher (39%) compared to second (31%) and third-and higher order births (30%) for the mother during 2001–2018, reflecting an overall trend of declining fertility.

Mother's age at birth of index child followed a similar pattern for both periods with around half of the mothers aged less than 25 years. A higher proportion of mothers from 2001 to 2018 completed secondary and higher education (56%) compared to the mothers during 1982–2000 (12%). The study samples in both periods were pre-dominantly Muslims (88% during 1982–2000 and 90% during 2001–2018). Both the samples were equally distributed by wealth. The proportion of mothers having a history of induced abortion was 7% before 2001 and 6% from 2001 to 2018.

Trend in sex ratio at birth over 1982–2018 in Matlab

Figure 1 presents the trend in SRB in Matlab by 3-year average. To maintain equal intervals, we included data from 1983 to 2018 in the analysis. SRB was within the natural limit during this period.

Sex ratio at birth by background characteristics

SRB among women with a history of induced abortion was as high as 109.2 during 1982–2000, and severely skewed with 113.5 during 2001–2018. Small number of women with induced abortion resulted in large Confidence Intervals.

Table 1 Sex ratio at birth in Matlab before and after introduction of ultrasonogram by background characteristics

Characteristics	1982–2000, *N* = 114,753				2001–2018, *N* = 91,637			
	Distribution of births, %	Number of births	SRB (M/F)	95% CI for SRB	Distribution of births, %	Number of births	SRB (M/F)	95% CI for SRB
Mother's age at birth of index child <=24	46.84	53,751	104.3	102.6-106.1	47.02	43,093	105.8	103.8-107.8
25–29	26.62	30,549	103.7	101.4–106.0	26.62	24,427	103.3	100.7-105.9
>= 30	26.54	30,453	101.2	98.9-103.5	26.32	24,117	104.4	101.8-107.1
Mother's schooling No Education	59.68	66,375	102.9	101.4- 104.5	14.77	12,672	103.8	100.3-107.5
Primary	27.96	31,094	103.4	101.0-105.6	28.89	24,786	105.6	103.0-108.2
Secondary & Higher	12.36	13,750	105.8	102.4-109.4	56.33	48,319	104.2	102.3–106.0
Wealth index Poorest	16.49	17,508	104.1	101.1 -107.3	17.79	13,925	106.8	103.23–110.4
Poor	20.13	21,376	103.6	100.8- 106.4	19.40	15,185	103.7	100.6-107.3
Middle	20.96	22,258	103.9	101.2-106.7	20.02	15,674	102.7	99.5–106.0
Rich	21.19	22,503	101.7	99.1-104.4	21.67	16,964	102.7	99.7-105.9
Richest	21.23	22,538	104.7	102.0-107.5	21.13	16,545	105.4	102.3-108.7
Religion Muslim	87.74	100,687	103.4	102.1-104.7	89.80	82,293	105.0	103.5-106.4
Non-Muslim	12.26	14,066	102.7	99.4-106.2	10.20	9344	102.8	98.7–107.0
Birth order First	20.42	23,436	105.3	102.7-108.1	38.81	35,560	105.8	103.7-108.1
Second	27.82	31,929	104.0	101.9-106.5	31.26	28,645	102.9	100.5-105.3
Third-and higher	51.75	59,388	102.1	100.4-103.7	29.94	27,432	105.3	102.8-107.8
Having Induced abortion history Yes	6.84	7848	**109.3**	104.6-114.3	6.05	5548	**113.5**	107.6-119.6
No	93.16	106,905	103.0	101.7-104.1	93.95	86,089	104.4	102.8-105.6

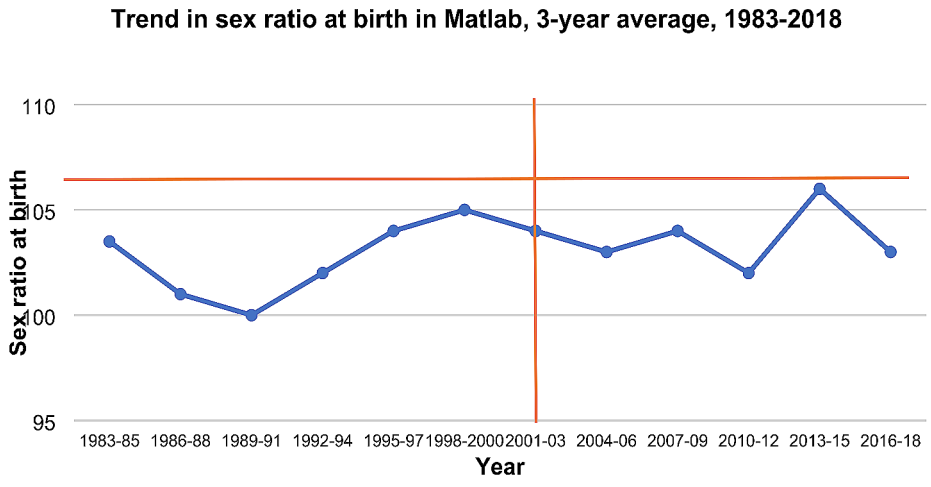

Fig. 1 Trend in sex ratio at birth over 1982–2018 in Matlab

The determinants of birth of a male child

Table 2 presents results from three sets of multivariate logistic regression analyses examining whether induced abortion during 1982–2018 and in pre and post advent of ultrasonography impacts the sex of the child born controlling for mother's age at birth of the child, education, religion, household wealth index and birth order of the child. The first model shows that the mother's history of induced abortion significantly increased the odds of a male birth 1.07 times over 1982–2018. We then examine whether this remains same for both the periods before (1982–2000) and after (2001–2018) introduction of ultrasonogram in Matlab by running two separate models. The second model assesses determinants of birth of a male child before the advent of ultrasonogram in Matlab (1982–2000) and the third – after introduction of

Table 2 Results of multivariate logistic regression of determinants of having a male child in Matlab, 1982–2018

Characteristics	1982–2018	1982–2000	2001–2018
	OR (95% CI)	OR (95% CI)	OR (95% CI)
History of induced abortion			
No (ref)			
Yes	1.07 (1.03–1.11)*	1.06 (1.01–1.11)*	1.08 (1.02–1.15)*
Mother's age at birth, year			
≤ 24 (ref)			
25–29	0.99 (0.97–1.01)	0.99 (0.97–1.03)	0.98 (0.95–1.02)
≥ 30	0.98 (0.96–1.01)	0.97 (0.94–1.01)	0.99 (0.94–1.03)
Mother's Education, year			
No Education (ref)			
Primary	1.01 (0.99–1.03)	0.99 (0.97–1.03)	1.03 (0.99–1.08)
Secondary and higher	1.01 (0.98–1.03)	1.00 (0.97–1.05)	1.02 (0.98–1.07)
Wealth index			
Poorest	1.01 (0.98–1.04)	1.00 (0.96–1.04)	1.02 (0.97–1.06)
Poor	0.99 (0.96–1.02)	0.99 (0.95–1.03)	0.99 (0.94–1.03)
Middle	0.99 (0.96–1.02)	1.00 (0.96–1.04)	0.97 (0.93–1.02)
Rich	0.97 (0.95-1.00)	0.97 (0.94–1.01)	0.97 (0.93–1.02)
Richest (ref)			
Religion			
Non-Muslim (ref)			
Muslim	1.02 (0.99–1.05)	1.01 (0.97–1.05)	1.03 (0.98–1.07)
Birth order			
First (ref)			
Second	0.99 (0.96–1.01)	0.98 (0.95–1.02)	0.98 (0.95–1.02)
Third-and higher	0.98 (0.96–1.01)	0.96 (0.93-1.00)	1.01 (0.97–1.06)
Log-likelihood	-127737.51	-73493.76	-54240.139
P-value	0.002	0.05	0.09
Estimate of Hosmer-Lemeshow gof test (P-value)	5.48 (0.705)	12.69 (0.123)	2.96 (0.937)
VIF (variance inflation factor)	1.55	1.54	1.74

*$p<0.05$.

ultrasonogram in Matlab (2001–2018). The second model shows that mother's history of induced abortion prior to introduction of ultrasonogram in Matlab (1982–2000) increased the odds of a male child 1.06 times. The results of the third model show that history of induced abortion significantly increased the odds of birth of a male child 1.08 times after introduction of ultrasonogram in Matlab (2001–2018). Log likelihood test indicates that all the three models are better compared to the null models (model 1 at 5% level of significance and model 2 and 3 at 10% level of significance). No collinearity was detected in any of models (VIF < 2) and as assessed by Hosmer–Lemeshow goodness of fit test the model fit was good ($p > 0.05$) for all three models.

Discussion

Using a unique longitudinal dataset covering a period between 1982 and 2018, the current study finds that SRB was normal in Matlab. Further analysis shows that SRB was, however, skewed for mothers with induced abortion. It was 109 before the advent of ultrasonogram (1982–2000), while it jumped up to 113 after introduction of ultrasonogram (2001–2018). To our knowledge this is the first ever study to present evidence on skewed SRB among women who had induced abortion, and that the skewness increased when ultrasonogram became available. Thus, it is evident that normal SRB can mask skewed SRB in sub-groups. These findings also suggest that GBSS may be hidden in sub-groups.

Most of the previous studies on GBSS in Bangladesh were based on cross-section data, the sample size was often inadequate for such analysis and most importantly longitudinal data on the same individuals on induced abortion and sex of the child born were not analyzed [7, 12, 18–20]. Using multivariate analyses of longitudinal data, the current study shows that after introduction of ultrasonogram in Matlab, induced abortion increased the odds of birth of a male child by 1.08 times, while it was 1.06 before its introduction. This may suggest presence of GBSS in this sub-group after introduction of ultrasonogram.

One may posit that since detection of fetal sex using ultrasonogram is not possible within the safe period for abortion ultrasonogram does not pose a threat of GBSS.

The literature, however, points out that most induced abortions in Bangladesh occur after the legal period of MR [11] (i.e., 12 weeks) and not in public health facilities that more or less adhere to the MR policy [21]. Thus, in case of later induced abortion fetal sex determination using ultrasonogram makes GBSS plausible.

It is important to note that our study has been conducted in a population with non-skewed SRB and it still detected a higher likelihood of birth of a male child among women with an induced abortion. Spatial variation in SRB is high in Bangladesh. Thus, in regions with highly skewed SBR, the odds of birth of a male child among women having induced abortion may be higher.

A limitation of this study is that due to complexity of accessing data, sex of the previous children, an important potential determinant of GBSS could not be included in the multivariate analyses [22]. Moreover, a multitude of unobserved factors may have influenced our model fit. Thus, further research is absolutely necessary to generate robust results on the relationship between sex selection technology and GBSS. It will be particularly important to study this relationship in geographic areas with highly skewed SRB, where the risk of GBSS may be higher.

Conclusions

Normal SRB masked skewed SRB in sub-groups. Induced abortion after the advent of ultrasonogram increased the likelihood of birth of a male child in a context with normal SRB. These findings suggest plausibility of GBSS in a sub-group. Studies need to be conducted in regions with skewed SRB to examine whether the odds of birth of a male child is even higher in such context and whether it is linked to GBSS.

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Author contributions

The study was conceived by RTN and designed by RTN, JFA and KP. All authors contributed to model construction. The data were analyzed by JFA guided by RTN. The manuscript was drafted by RTN and JFA and revised critically for important intellectual content by all authors (KP, MMH and MAH). All authors approved the version to be published.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available based on icddr, b policy, but are available from the corresponding author for reasonable requests.

Declarations

Ethics approval and consent to participate

Ethical approval and consent to participate Ethical approval for this study was obtained from icddr, b research, and ethical review committee (PR-20104). The activities and operations of the Matlab HDSS are approved by icddr, b Institutional Review Board. As described by Alam et al., the HDSS obtained informed consent from the household heads to participate in the HDSS's continuous data collection activities. A signature or thumb impression was obtained on the consent form from the households that agreed to participate [16].

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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References

1. Guilmoto CZ. Skewed sex ratios at birth and future marriage squeeze in China and India, 2005–2100. Demography. 2012;49(1):77–100.
2. Edlund L, Li H, Yi J, Zhang J. Sex ratios and crime: evidence from China. Rev Econ Stat. 2013;95(5):1520–34.
3. South SJ, Trent K. Imbalanced sex ratios, men's sexual behavior, and risk of sexually transmitted infection in China. J Health Soc Behav. 2010;51:376–90.
4. South SJ, Trent K, Bose S. Skewed sex ratios and criminal victimization in India. Demography. 2014;51:1019–40.
5. Kumar S, Sinha N. Preventing more missing girls: a review of policies to tackle son preference. World Bank Res Obs. 2020;35(1):87–121.
6. Channon MD, Puri M, Gietel-Basten S, Stone LW, Channon A. Prevalence and correlates of sex-selective abortions and missing girls in Nepal: evidence from the 2011 Population Census and 2016 demographic and Health Survey. BMJ open. 2021;11(3):e042542.
7. UNFPA. Bangladesh Country Profile. Global Programme to prevent Son Preference and the undervaluing of girls: improving the sex ratio at birth in select countries in Asia and the Caucasus. Dhaka: UNFPA; 2020.
8. Kashyap R, Villavicencio F. An agent-based model of sex ratio at birth distortions. In Agent-based modelling in population studies: Concepts, methods, and applications. Cham: Springer International Publishing. 2016;343–367.
9. Asadullah MN, Mansoor N, Randazzo T, Wahhaj Z. Is Son Preference Disappearing from Bangladesh? Discussion Paper Series. 2021; IZA DP No. 13996. IZA – Institute of Labor Economics.
10. Asadullah MN, Mansoor N, Randazzo T, Wahhaj Z. Is son preference disappearing from Bangladesh? World Dev. 2021;140:105353. https://doi.org/10.1016/j.worlddev.2020.105353.
11. Talukder M, Rob U, Noor FR. Assessment of Sex Selection in Bangladesh. Dhaka: Population Council; 2014.
12. Department of Population Sciences, University of Dhaka (DPSDU). Exploring gender-biased sex selection in Bangladesh: causes and consequences. Dhaka, Bangladesh: University of Dhaka; 2019.
13. Government of the People's Republic of Bangladesh. Directorate general of family planning: MCH-services unit. Memorandum no.: DGFP/MCH-RH/prosha (admin) 23/05/108; 2015.
14. Huda FA, Mahmood HR, Alam A, Ahmed F, Karim F, Sarker BK, et al. Provision of menstrual regulation with medication among pharmacies in three municipal districts of Bangladesh: a situation analysis. Contraception. 2018;97(2):144–51.
15. The Daily Star. HCD rules on prenatal sex determination. 2020. https://www.thedailystar.net/law-our-rights/news/hcd-rules-prenatal-sex-determination-1866436
16. Alam N, Ali T, Razzaque A, Rahman M, Zahirul HM, Saha SK, et al. Health and demographic surveillance system (HDSS) in Matlab, Bangladesh. Int J Epidemiol. 2017;46(3):809–16.
17. World Health Organization. Preventing gender-biased sex selection: an interagency statement-OHCHR, UNFPA, UNICEF, UN women and WHO. World Health Organization; 2017.

18. Kabeer N, Milward K, Sudarshan R. Organising women workers in the informal economy. Gend Dev. 2013;21(2):249–63.
19. Population Council and Center for Research on Environment Health and Population Activities (CREHPA). Gender-biased sex selection and unbalanced sex ratios at birth in South Asia: case-studies of the situation and promising approaches to restore balance. New Delhi: Population Council; 2015.
20. Department of Population Sciences, University of Dhaka (DPSDU). Exploring gender-biased sex selection in Bangladesh: a review of the Situation. Dhaka, Bangladesh: University of Dhaka; 2018.
21. Vlassoff M, Fetters T, Kumbi S, Singh S. The health system cost of post abortion care in Ethiopia. Int J Gynecol Obstet. 2012;118:S127–33.
22. Singh A, Kumar K, Yadav AK, James KS, McDougal L, Atmavilas Y et al. Factors influencing the sex ratio at Birth in India: a New Analysis based on births occurring between 2005 and 2016. Studies in family planning. 2021; 52(1): 41–58.

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