

# Household food insecurity is independently associated with poor utilization of maternal healthcare services in Bangladesh

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## Abstract

**Introduction:** Food insecurity at the individual level has been shown to be associated with the adoption of risky behavior and poor healthcare-seeking behavior. However, the impact of household food insecurity (HFI) on the utilization of maternal healthcare services (MHS) remains unexplored. In this study, we aimed to investigate whether or not household food insecurity was associated with non/inadequate utilization of MHS.

**Methods:** Participants consisted of 3562 mothers aged between 15 and 49 years and with at least one child. The outcome variable was the utilization of MHS, e.g., institutional delivery, attendance ante-, and pre-natal visits. The explanatory variables included various sociodemographic factors (e.g., age, residence, education, wealth) apart from HFI. HFI was measured using the Household Food Insecurity Access Scale (HFIAS).

**Result:** The prevalence of non- and under-utilization of MHS was 5.3 and 36.5, respectively. In the multivariate analysis, HFI, wealth index, and educational level were independently associated with MHS status. The odds of non- and under-utilization of MHS were 3.467 (CI = 1.058–11.354) and 4.104 (CI = 1.794–9.388) times higher, respectively, among women from households reporting severe food insecurity.

**Conclusion:** Severe HFI was significantly associated with both under- and non-utilization of MHS. Interventions programs that address HFI and the empowerment of women can potentially contribute to an increased utilization of MHS.

**Key words:** antenatal care, Demographic and Health Survey, food insecurity, maternal healthcare services



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## Introduction

The key role that maternal healthcare services (MHS) plays in reducing maternal mortality rate (MMR) has been substantiated by researchers both in developed and developing country contexts (Cleland et al. 2006; Dowswell et al. 2010; Adegoke et al. 2012; Finlayson and Downe 2013). However, developing regions, especially South Asia and sub-Saharan Africa, are lagging behind the rest of the world in their capacity to put this knowledge into practice (Bishwajit 2015). Initiatives

led by the maternal health-related millennium development goal (MDG) 5 initiative saw a 34% decline in MMR since 1990 (Dynes et al. 2013). Despite that, MMR in low- and middle-income countries (LMICs) remains alarmingly high and reveals a continuing disparity in the provision and utilization of MHS in these countries (Kassebaum et al. 2014). A systematic review found that LMICs together account for almost all of the total maternal mortalities (99%) (Hogan et al. 2010), with South Asian countries representing about one third of the global total (Zanconato et al. 2006). Globally, about 97% of the unsafe abortions occur in LMICs and this contributes to about 15% of total maternal mortality (Baer et al. 2015).

The difference in the burden of MMR between high-income countries (HICs) and LMICs coincides with that of the utilization of MHS. In developed countries about 98% of women receive adequate antenatal care (ANC) services and skilled birth attendants supervise 94% of the deliveries (Zanconato et al. 2006), whereas in LMICs about half of all women remain deprived of basic ANC (Finlayson and Downe 2013). This strikingly high divide is generally attributed to poor healthcare infrastructure, health illiteracy, underutilization of maternal health care and family planning, and inadequate access to obstetric care (Lewis 2003; Cleland et al. 2006; Zanconato et al. 2006; Nour 2008), all of which are widely prevalent across south Asian countries including Bangladesh.

Bangladesh has made appreciable progress in its pursuit of reducing maternal and under-five child mortality rates. Despite that, the mortality rates continue to be noticeably high when compared with high-income countries. Generally, this discrimination is attributed to the underutilization of MHS, and financial and infrastructural barriers to access to quality care in the current socioeconomic context. For instance, researchers mentioned that although the lack of affordability of healthcare is a major problem, the role of women empowerment and decision-making power for proper utilization of MHS is also a key issue in the country (Yaya et al. 2017). MHS is provisioned mainly through public and private establishments, as well as community healthcare centers, with traditional care providers being more prevalent in the rural areas. The costs of care vary widely, with the private hospitals being the most expensive and hence unaffordable for the majority of the population. To overcome this barrier, the government has taken initiatives to provide service through community healthcare centers that are widely distributed throughout the country.

Previous studies have reported that in Bangladesh, the majority of maternal deaths occur during the time between the third trimester and the first week following delivery (Winch et al. 2005). These deaths could be prevented to a considerable extent by proper information and guidance for maternal health-seeking behavior disseminated through prenatal/maternal education programs (Moran et al. 2007). However, designing such programs will require massive efforts, including a great amount of financing and research work to develop a deep understanding of the factors that influence maternal healthcare-seeking behavior (HSB). This can be a crucial step towards evidence-based health policy making that targets better infant and maternal health outcomes (Darmstadt et al. 2005).

Maternal HSB, like any health-related behavior, is by nature a complex psychological construct that is shaped at individual, familial, and social levels by various demographic, economic, and sociocultural forces. In the domain of behavioral psychology, the stress agents (stressors) hold a central position as they have been shown to affect almost all aspects of psychosocial life via behavioral pathways, e.g., mood, lifestyle factors, perception of health, and well-being (Moran et al. 2007). Food insecurity, although generally thought of as an outcome of financial or resource constraints (Baer et al. 2015), is also found to be affected by behavioral aspects (Timmer 2012). Previous studies have outlined the impact of proximate socioeconomic stressors such as poverty and food vulnerability on HSB (Sundari Ravindran 2014; Young et al. 2014). It is, therefore, assumable that women who face

hardships to secure food will face the trade-off between nutrition and medical care that will eventually lead to non- or under-utilization of maternal healthcare. A previous study on American households reported that housing instability and food insecurity were associated with poor access to healthcare (Bhargava and Lee 2016). Based on current literature, we hypothesized that household food insecurity (HFI) would be associated with suboptimal utilization of MHS. Given the high rate of HFI and maternal and infant mortality, the findings are expected to be of crucial importance for public health policy making in the country.

## Methods

### Data source

We used cross-sectional datasets extracted from the sixth round of the Bangladesh Demographic and Health Survey (BDHS). BDHS is a nationally representative survey that collects information on various demographic, socioeconomic, and health indicators among adult men (15–59 years), women (15–49 years), and infants (children under 5 years). The survey was conducted by the National Institute of Population Research and Training (NIPORT), a renowned health research organization in Bangladesh (NIPORT et al. 2013). The survey is a part of the International Demographic and Health Survey program known as the MEASURE Demographic and Health Survey (DHS), which is currently active in 90 countries, and was conducted under the auspices of the United States Agency for International Development (USAID) and the technical assistance of ICF International in Calverton, Maryland, USA. Details regarding the sampling and data collection methods are available from the publication by NIPORT (NIPORT et al. 2013).

### Variables

MHS utilization status was the outcome variable in this study. The independent variable of primary interest was HFI.

#### Food insecurity

DHS utilizes a retrospective method called the Household Food Insecurity Access Scale (HFIAS) to measure the prevalence and degree of HFI. The scoring system is based on responses to following yes or no questions: (1) had three square meals in the past 12 months, (2) skipped entire meals in the past 12 months, (3) ate less food in the past 12 months, (4) ate wheat or rice in the past 12 months, and (5) asked for food from relatives or neighbors in the past 12 months. Scores range from 0 to 15, with 0 representing the most secure and 15 the least secure. This scaling method was originally developed by the USAID-funded Food and Nutrition Technical Assistance (FANTA) project. For this study, HFI status was dummy coded into four groups in the following manner: 0 = Secure, 1 to 5 = moderately food secure, 6 to 10 = insecure, and 11 to 15 = severely insecure. The HFIAS scale was previously validated for Bangladesh (Swindale and Bilinsky 2006).

#### MHS

A literature review assisted in the selection of proximate socioeconomic, demographic, and individual level factors for MHS.

Maternal healthcare utilization status is usually measured by two composite elements based on the services: (1) childbirth (place of delivery) and (2) before and after childbirth (ANC and postnatal care (PNC) visits) (Baer et al. 2015). Based on these two elements, MHS utilization status was categorised into three groups. Group 1 consisted of those who received service neither at childbirth nor ANC and PNC services (at least one ANC and PNC attendance), group 2 consisted of those who received either of the two, and group 3 consisted of those who received both types of services.

First, a participant was considered as not using MHS provided the place of delivery was the home; this was dichotomized as the home (whether of the participant or relatives) versus a health institution (i.e., medical college hospital, upazila health complex, maternal and child welfare center, or health and family welfare centre). Second, a participant was considered as not using MHS before or after delivery unless she had at least one ANC and one PNC visit.

To select the potentially relevant covariates in the context of maternal health behavior, an extensive literature review was conducted focusing on the three most proximate themes: demographic status, socioeconomic status, and media use. As per availability in the dataset, the following were included in the analysis: age, region, residency, religion, education level of the participant and her husband, working status of the participant, type of employment of the husband, household wealth index, household having electricity, membership in any microcredit institution, autonomy in decision-making (being able to decide how spend personal income and on own health care), and media use (newspaper, TV, and radio).

### Age

Age was trichotomized into three groups: 11–24 years, 25–34 years, and 35–49 years. Participants in all seven administrative regions including Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet were included in this study. Place of residency was categorized as rural or urban. Religion was categorized into Islam (the dominant faith in the country), and others (Hinduism, Buddhism, and Christianity). The working status of participants was categorized as employed or unemployed.

### Educational status

Growing evidence suggests that educational status is one of the most direct indicators of population health and health-related behavior. The educational statuses of both the participant and their husband were categorized into four groups based on the total number of years of formal education received: 0 = nil, 1 = primary (1–5 years), 2 = secondary (6–10 years), and 3 = higher (>10 years).

### Occupation

Type of occupation was categorized as follows: (1) farming = farmer, agricultural worker, fisherman, poultry farmer, and cattle raising; (2) blue-collar jobs = carpenter, mason, driver, construction worker, rickshaw puller, brick breaking, and road building; (3) white-collar jobs = businessman, physician, lawyer, accountant, teacher, and government service holder; (4) others = student, religious leader, retired, and unemployed.

### Wealth index

Household wealth status was categorized as follows: poor, poorest, middle, rich, and richest. Households were ranked by the score they were assigned based on the possession of durable goods (e.g., TV, radio, refrigerator, and construction material). Categorization was performed by dividing the household wealth scores into quintiles. The richest households were those in the highest quintile, and poorest were in the lowest quintile. The procedures for calculating wealth status in DHS studies have been explained in previous studies (Yaya et al. 2017).

### Microcredit institution membership

Microfinance programs have been shown to have a positive impact on women's empowerment and to promote overall socioeconomic status. Mothers who are involved with such programs are expected to have better economic solvency and therefore better adherence to maternal care protocols. Participants of this study were categorized according to their membership with any of the four microcredit institutions (Association for Social Advancement (ASA), Bangladesh Rural Advancement Committee

(BRAC), Bangladesh Rural Development Board (BRDB), and Grameen Bank) as follows: 0 = no membership; 1 = membership with at least one institution or with multiple institutions.

#### *Media use*

Utilization of paper and electronic media has been shown to promote health awareness among adults. In this study, media use status was measured by the habit of watching TV, listening to radio, and reading newspaper as follows: 0 = not using at all; 1 = using sometimes/regularly.

## Statistical analysis

The initial dataset was checked for cases that fulfilled all of the inclusion criteria, and data were entered into a separate working file for analysis. To ensure data accuracy the new dataset was rechecked for outliers and missing values by two independent authors. In total, 3562 cases were retained in the final dataset.

The dependent variable was trichotomized into three easily distinguishable groups based on the utilization of services of the two different types as described earlier (i.e., during delivery, and before and after delivery). The three groups (group 1, 2, and 3) indicated non-, under-, and full utilization of MHS.

First, a frequency table was created to describe the baseline characteristics of the study participants. Following that,  $\chi^2$  bivariate analysis was performed to detect the variables that significantly contributed to MHS utilization status. The variables that showed statistical significance (at  $p < 0.25$ ) in bivariate analysis were selected for regression analysis. A multinomial regression model was used to determine the association between HFI and MHS. The results of the regression analysis were reported in terms of odds ratios and 95% confidence intervals. The  $p$ -values were only considered statistically significant when  $<0.05$ . All analyses were performed using SPSS version 21.0 for MAC (SPSS Inc., Chicago, Illinois, USA).

## Ethical clearance

Informed consent was obtained from all participants before each interview. This study is not subject to further ethical approval because the data are secondary and available in the public domain in an anonymized form.

## Results

### Sample characteristics

**Table 1** shows the baseline characteristics of the study population ( $n = 3652$ ). About three fifths of the participants were of rural origin, and participation was highest in the Chittagong district. Most of the participants belonged to the age group of 15 to 24 years. About 88.7% of them were Muslim, which is close to the proportion observed at the country level ( $\sim 89.5$ ). Almost half of the women completed secondary school and 15% achieved above secondary level. The overall literacy rate was higher among women (89.3%) than among their husbands (82.1%). However, the percentage of participants with qualifications above the secondary school level was higher among the husbands. One fourth of the study participants were microcredit borrowers. However, nearly 90% of the women were non-working mothers. The majority of participants belonged to highest wealth quintile (32%), which may be because in about one third of the cases, the husbands were white-collar employees in the most well-paid job categories. Only 1 in 10 women had the ability to make health decisions independently. The percentage was even lower (8.6%) for decisions about spending personal income. The majority of the women were from households with good (72.2%) to moderately good (21.6%) level of food

**Table 1.** Background characteristics of the study participants.

Variables	Frequency	Percentage (%)
<b>Age</b>		
15–24	1792	50.3
25–34	149	40.2
35–49	271	7.6
<b>Residency</b>		
Urban	1458	40.9
Rural	2104	59.1
<b>Region</b>		
Barisal	393	11
Chittagong	620	17.4
Dhaka	590	16.6
Khulna	530	14.9
Rajshahi	470	13.2
Rangpur	488	13.7
Sylhet	471	13.2
<b>Religion</b>		
Islam	3161	88.7
Others	401	11.3
<b>Education level of the participant</b>		
Nil	381	10.7
Primary	867	24.3
Secondary	1777	49.9
Higher	537	15.1
<b>Education level of the husband</b>		
Nil	636	17.9
Primary	899	25.2
Secondary	1230	34.5
Higher	797	22.4
<b>Microcredit borrower</b>		
Yes	907	25.5
No	2269	63.7
<b>Wealth index</b>		
Poorest	460	12.9
Poorer	507	14.2
Middle	633	17.8
Richer	822	23.1

(continued)

Table 1. (concluded)

Variables	Frequency	Percentage (%)
Richest	1140	32
<b>Participant currently working</b>		
Yes	369	10.4
No	3193	89.6
<b>Husband's occupation</b>		
Farming	427	12
Blue-collar jobs	987	27.7
White-collar jobs	1290	36.2
Others	858	24.1
<b>Food security level</b>		
Severely insecure	35	1
Insecure	187	5.2
Moderately secure	768	21.6
Secure	2572	72.2
<b>Household has electricity</b>		
Yes	2655	74.5
No	907	25.5
<b>Has a say in own health care decisions</b>		
Yes	419	11.8
No	3143	88.2
<b>Can decide on spending personal income</b>		
Yes	308	8.6
No	3254	91.4
<b>Reads newspaper</b>		
Yes	931	26.1
No	2631	73.9
<b>Watches TV</b>		
Yes	2543	28.6
No	1019	71.4
<b>Listens to radio</b>		
Yes	367	10.3
No	3195	89.7

security. Women from 1% of the households faced severe food insecurity. About one fourth of the women reported having the habit of reading newspapers. Although three fourths of women reported living in a household with access to electricity, the rate of utilization of electronic media was quite low (28.6 for television and 10.3 for radio).



## Factors influencing the utilization of MHS (bivariate association)

Based on the Pearson's  $\chi^2$ -test result (shown in [Table 2](#)), the following variables were found to be significantly associated with MHS utilization status: residency, education level of the participant and her husband, occupation category of the husband, household wealth index, microcredit institution membership, and level of food security. Age, religion, and regional variation showed no association.

Participants of rural origin had a lower likelihood of utilizing MHS compared with their urban counterparts. Women whose husbands were engaged in white-collar jobs were more likely to utilize MHS. Women with no education had higher probability of underutilization of MHS and had almost seven-fold the risk of non-utilization compared with the most educated. Women belonging to highest wealth group index had notably higher maternal service attendance than the poorest group (10.1 vs. 36.8). The poor and poorer groups combined accounted for 56% of the women who didn't receive any service.

Household wealth index and level of food security were significantly associated with the utilization of MHS of both types. For husbands, the type of occupation and level of education showed significant associations.

Quite unexpectedly, working status and decision-making ability were not found to be significantly associated with MHS uptake. Seven predictors were found to be significant at  $p < 0.05$  and were entered into the multivariate analysis.

## Multivariate analysis

Of the seven variables entered into the multivariate analysis, the following three were found to be significantly associated with non- and under-utilization of MHS: educational level of the participant, household wealth index, and household food security level. The impacts of the husband's characteristics (educational level and type of occupation), media utilization (television, radio, and newspaper), and women's decision-making status were found to be insignificant after adjusting for confounding factors.

The level of education of the participant was found to be significantly associated with both non- and under-utilization of MHS ([Table 3](#)). The odds of not utilizing any service were 10 times higher for women with no formal education compared with their most educated counterparts. Women who completed primary education had 6.80 and 1.43 higher odds of non- and under-utilization of MHS, respectively. However, for women with secondary level qualification, educational status showed no significant impact on their service utilization status.

Results also revealed that the poorer the household, the higher the likelihood of non-utilization of MHS. Compared with the richest, the odds ratios of non-utilization of MHS were 7.814 (CI = 3.21–18.98) for the poorer and 9.28 (CI = 3.60–23.90) for the poorest.

The likelihood of MHS utilization decreased with the lowering of household food security level. Women from most food insecure households were four times more unlikely to utilize MHS of any form and 3.5 times more likely to underutilize MHS compared with those from food secure households. However, being moderately food secure showed no significant impact on MHS underutilization status.

## Discussion

This study documents the factors influencing the non- and under-utilization of MHS in Bangladesh. To our knowledge, this is first study to establish an association between HFI and



**Table 2.**  $\chi^2$  bivariate analysis results for the association between basic demographic and socioeconomic variables with the utilization status of maternal healthcare services.

Variables	Non-utilization (%) (n = 189, 5.3%)	Underutilization (%) (n = 1234, 34.6%)	Full utilization (%) (n = 2139, 60.1%)	p
<b>Age</b>				0.247
15–24	55	50	50.1	
25–34	34.9	42.9	42.2	
35–49	10.1	7.1	7.8	
<b>Residency</b>				<0.001 <sup>a</sup>
Urban	21.1	37.9	44.4	
Rural	78.8	62.1	55.6	
<b>Region</b>				0.169
Barisal	9	10.5	11.5	
Chittagong	19	17.6	17.2	
Dhaka	19	17.6	15.8	
Khulna	13.8	16	14.4	
Rajshahi	11.6	12	14	
Rangpur	10.1	12.6	14.6	
Sylhet	17.5	13.8	12.5	
<b>Religion</b>				0.059
Islam	93.1	89.5	87.9	
Others	6.9	10.5	12.1	
<b>Education level of the participant</b>				<0.001 <sup>a</sup>
Nil	28	13.5	7.6	
Primary	40.2	28.4	20.6	
Secondary	30.2	45.3	54.3	
Higher	1.6	12.9	17.5	
<b>Education level of the husband</b>				<0.001 <sup>a</sup>
Nil	37	21.6	14	
Primary	36	26.6	23.5	
Secondary	21.2	32.4	36.9	
Higher	5.8	19.4	25.5	
<b>Microcredit institution membership</b>				0.033 <sup>a</sup>
Yes	29.1	25.1	21.6	
No	70.9	74.9	78.4	
<b>Wealth index</b>				<0.001 <sup>a</sup>
Poorest	31.7	14.8	10.1	
Poorer	24.9	16	12.3	

(continued)

Table 2. (concluded)

Variables	Non-utilization (%) (n = 189, 5.3%)	Underutilization (%) (n = 1234, 34.6%)	Full utilization (%) (n = 2139, 60.1%)	p
Middle	21.2	18.9	16.8	
Richer	18	22.4	23.9	
Richest	4.2	27.9	36.8	
<b>Currently working</b>				0.938
Yes	11.1	10.4	10.3	
No	88.9	89.6	89.7	
<b>Food security</b>				<0.0001 <sup>a</sup>
Severely insecure	2.6	1.8	.4	
Insecure	14.8	6.2	3.8	
Moderately secure	29.1	25.2	18.8	
Secure	53.4	66.8	77	
<b>Household has electricity</b>				0.139
Yes	45.5	60.8	67	
No	55.5	39.2	33	
<b>Has a say in own health care decisions</b>				0.067
Yes	13.2	10	12.6	
No	86.8	90	87.4	
<b>Can decide on spending personal income</b>				0.494
Yes	10.6	8.1	8.8	
No	89.4	91.9	91.2	
<b>Husband's occupation</b>				<0.001 <sup>a</sup>
Farming	19.6	13.6	10.4	
Blue-collar jobs	20.6	28.1	28.1	
White-collar jobs	24.9	32.6	39.3	
Others	34.9	25.7	22.2	
<b>Reads newspaper</b>				0.861
Yes	25.4	25.7	26.5	
No	74.6	74.3	73.5	
<b>Watches TV</b>				0.075
Yes	73.5	69	72.6	
No	26.5	31	27.4	
<b>Listens to radio</b>				0.087
Yes	5.8	10	10.8	
No	94.2	90	89.2	

<sup>a</sup>Significant at  $p < 0.05$ .

**Table 3.** Results of the binary logistic regression on the factors associated with non- and under-utilization of maternal healthcare services.

	Non-utilization			Underutilization		
	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI
<b>Residency</b>						
Rural	NS	0.68	0.45–1.03	NS	0.88	0.74–1.04
Urban (Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
<b>Education level of the participant</b>						
Nil	<0.001 <sup>a</sup>	10.45	2.80–19.00	0.004 <sup>a</sup>	1.69	1.18–2.43
Primary	0.003 <sup>a</sup>	6.80	2.88–14.62	0.019 <sup>a</sup>	1.43	1.06–1.94
Secondary	NS	3.05	1.88–7.60	NS	1.00	0.78–1.29
Higher (Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
<b>Education level of the husband</b>						
Nil	NS	1.28	0.81–2.01	NS	1.15	0.84–1.56
Primary	NS	0.67	0.43–1.03	NS	1.00	0.76–1.31
Secondary	NS	1.31	0.84–2.03	NS	0.95	0.75–1.20
Higher (Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
<b>Husband's occupation</b>						
Farming	NS	1.18	0.92–1.52	NS	1.18	0.92–1.52
Blue-collar	NS	0.97	0.79–1.18	NS	0.97	0.79–1.18
White-collar	NS	0.96	0.78–1.19	NS	0.96	0.78–1.19
Others (Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
<b>Wealth index</b>						
Poorest	<0.001 <sup>a</sup>	9.28	3.60–23.90	NS	1.00	0.69–1.45
Poorer	<0.001 <sup>a</sup>	7.81	3.21–18.98	NS	1.06	0.77–1.45
Middle	<0.001 <sup>a</sup>	6.27	2.73–14.35	NS	1.13	0.88–1.46
Rich	<0.001 <sup>a</sup>	4.37	1.95–9.76	NS	1.04	0.84–1.29
Richest	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
<b>Microcredit borrower</b>						
Yes	NS	1.02	0.71–1.45	NS	0.93	0.78–1.11
No	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
<b>Food security level</b>						
Severely insecure	0.001 <sup>a</sup>	4.10	1.79–9.38	0.040 <sup>a</sup>	3.46	1.058–11.354
Insecure	NS	1.31	0.92–1.86	NS	1.61	0.94–2.74
Moderately secure	0.017 <sup>a</sup>	1.25	1.04–1.51	NS	0.99	0.68–1.45
Secure	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)

**Note:** Reference category: Group 3. Ref, denotes the reference category; NS, not significant; OR, odds ratio.

<sup>a</sup>Significant at  $p < 0.05$ .

MHS utilization status. The findings of the study were well in line with the study hypothesis. In addition to the main findings, the study also revealed that the rate of MHS attendance in the sample population was quite low. A review of the literature suggests that a similar scenario exists in most other countries in South Asia (Moran et al. 2007; Singh et al. 2012), contributing to the remarkably high MMR among the impoverished population (Vora et al. 2009; Yaya et al. 2017).

HFI, as the explanatory variable of primary interest in this study, was found to be significantly associated with MHS utilization status. Previous studies have demonstrated the link between chronic food vulnerability and the poor uptake of healthcare services (Kushel et al. 2001). Poor households usually have to spend the bulk of their income on food, and as a consequence face hard trade-offs between food and other competitive necessities such as education and healthcare (Bishwajit et al. 2014). Findings are similar even from studies in the USA where the expenditure on food as a percentage of total disposable income is one of the lowest among all countries (Kushel et al. 2001). A study following the food crisis of 2008 exploring households' coping strategies in Bangladesh found that the rise in food prices was associated with the decreased consumption of rice (a staple food in Bangladesh), increased student dropout at the high school level (with higher proportions for girls), and elevated levels of domestic violence, which all result in significantly adverse effects on the utilization of MHS (Raihan 2009). The Bangladesh Government has periodically launched many food security initiatives to safeguard the health and nutrition of its marginalized population. The findings of this study suggest that national food policy making targeting the promotion of food security among socioeconomically disadvantaged communities will substantially contribute to the increased utilization of MHS. Successful integration of social awareness programs targeting the sociocultural barriers to promoting maternal health and countrywide food security programs can prove highly rewarding. Nonetheless, mothers and female children were found to be deprived of food in households (Kushel et al. 2001; Baig-Ansari et al. 2006).

To our knowledge, there is no prior study exploring the association between MHS and HFI using nationally representative data. A strong point of this study is that we used data from the latest DHS survey performed in the country. Also of importance is the cluster sampling method of the study population, which means that sample participants were representative of the general population. However, using secondary data meant that authors had no control over the selection of variables, the quality of the data, and the measurement of the indicators. The rate of MHS utilization rate might have changed since the survey was conducted. Moreover, we did not control for geographic barriers to MHS, which has been shown to have influences on HSB.

## Conclusion and policy suggestions

Women from food insecure households are less likely to receive MHS than their food secure counterparts. Household wealth status and individual educational level were also strongly correlated with the demand for MHS. The findings of this study bear important policy implications for designing reproductive healthcare services in Bangladesh. Health policies targeted at promoting maternal health and services utilization must emphasize improving food security and the economic empowerment of marginalized households, especially when there is a pregnant woman. Further studies should focus on the potential of food-security-based approaches to improve maternal health utilization in Bangladesh.

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## Author contributions

GB conceived and designed the study. GB performed the experiments/collected the data. GB and SY analyzed and interpreted the data. GB and SY contributed resources. GB and SY drafted or revised the manuscript.

## Competing interests

The authors have declared that no competing interests exist.

## Data accessibility statement

All relevant data are within the paper.

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