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Factors associated with the place of delivery among ever-married women in Bangladesh

A secondary analysis of the Bangladesh Demographic and Health Survey, 2014

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Abstract

Background

Although the maternal mortality ratio has dropped globally, the ratio is still unacceptably high in many low and lower-middle-income countries, like Bangladesh. Maternal deaths can occur from preventable complications due to pregnancy and childbirth. Delivery at a health institution was proven to be one of the key interventions to minimize maternal mortality. This study aimed at investigating the associations between the socio-demographic and healthcare-related factors, and the place of delivery among ever-married women of reproductive age in Bangladesh.

Methods

A population-based cross-sectional study was conducted with 4487 ever-married women, aged 15-49 years. Data were extracted from the 2014 Bangladesh Demographic and Health Survey. To investigate the associations, multivariate logistic regression was performed.

Results

Of the 4487 ever-married women, 1794 (40%) gave birth by institutional delivery. Multivariate logistic regression showed that wealthier women, attending secondary or above education levels, and whose husbands had primary or above education were more likely to deliver at health institutions. Women who received counselling about danger signs and attended at least one or more ANC visits during pregnancy had higher odds of institutional delivery. Women living in rural areas, following Islam religion, and who were currently working were less likely to deliver at health institutions.

Conclusion

The current study revealed that the socio-demographic and healthcare-related factors were associated with the place of delivery among ever-married women of reproductive age in Bangladesh.

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List of abbreviations

ANC	Antenatal care
BANC	Basic antenatal care
BBS	Bangladesh Bureau of Statistics
BDHS	Bangladesh Demographic and Health Survey
BMMS	Bangladesh Maternal Mortality Surveys
BR	Birth Recode
CI	Confidence interval
DHS	Demographic and Health Survey
EAs	Enumeration areas
FANC	Focused antenatal care
GDP	Gross domestic product
HDI	Human development index
HIV	Human Immunodeficiency Virus
ICF	Informed Consent Form
IRB	International Review Board
MCWC	Maternal and child welfare centre
MHS	Maternal health services
MMR	Maternal mortality ratio
MNHIB	Maternal and Neonatal Health Initiatives in Bangladesh
MDGs	Millennium Development Goals
NIPORT	National Institute of Population Research and Training
NGOs	Non-government organizations
OOP	Out-of-pocket

OR   Odds ratio

SPSS   Statistical Package for Social Sciences

SDGs   Sustainable Development Goals

TBAs   Traditional birth attendants

UN   United Nations

UNDP   United Nations Development Programme

UNICEF   United Nations Children's Fund

UNFPA   United Nations Population Fund

USAID   United States Agency for International Development

VIF   Variance Inflation Factor

WHO   World Health Organization

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1 Introduction

Among the women of reproductive age, complications due to pregnancy and childbirth are the leading cause of death and disability around the world, especially in developing countries (1). The choice of place of delivery found to be correlated with the maternal outcomes as well as the neonatal outcomes (2). Delivery within the health facilities, while attended by the skilled healthcare providers is associated with lower rates of maternal mortality and morbidity, compared to home births (3,4). The utilization of institutional delivery is considered as the cornerstone and one of the key interventions to minimize maternal deaths (5).

1.1 Maternal mortality as a global aspect

The issue of maternal mortality and morbidity is a major public health concern globally (6,7). According to the World Health Organization (WHO), around 295 000 women died worldwide due to the preventable complications arising from pregnancy and childbirth in 2017 (8). The WHO suggested that approximately 810 women died every day following pregnancy and childbirth-related complications in the same year. The maternal mortality ratio (MMR) is defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period (9). The global MMR was estimated at 342 maternal deaths per 100,000 live births in 2000. This reduced to 211 maternal deaths per 100,000 live births in 2017 (9). Although the global MMR has dropped down to about 38% between 2000 and 2017, the MMR in low income countries is still unacceptably high (about 462 maternal deaths per 100,000 live births) (8). Moreover, a vast majority (94%) of the total global maternal deaths occurred in the low and lower-middle-income countries (8). In 2017, approximately 86% (254 000 deaths) of the total estimated global maternal deaths were accounted for by Sub-Saharan Africa and Southern Asia (8). Sub-Saharan Africa accounted for around two-thirds of the maternal deaths (196 000) alone, whereas about one fifth (58000) of these total maternal deaths occurred in the South Asian regions (8).

Women usually die due to the complications that develop during pregnancy or after the childbirth, and most of the complications in the pregnancy period are preventable and treatable. Some other complications may develop before pregnancy, but they usually get worse if they remain untreated during maternal care. The five major complications that are responsible for almost 75% of all the maternal deaths include severe bleeding, occurring

usually after the childbirth, unsafe abortion, infections or sepsis, complications from delivery, and high blood pressure during pregnancy, known as pre-eclampsia or eclampsia (8,10). Apart from that, infections like malaria or, chronic conditions such as diabetes and cardiac diseases contribute to the remainder of maternal deaths (8).

1.2 Millennium Development Goals and Sustainable Development Goals

In 2000 Millennium summit, a total of 189 member states of the United Nations (UN) signed the United Nations Millennium Declaration, in which one of the prior issues was to improve maternal health. The pledge created the Millennium Development Goals (MDGs), to be achieved by 2015 and the Safe motherhood program initiated in 2001 following the event (11). Among the eight MDGs, goal number five (MDG 5) aimed at a 75% reduction in the MMR and achieving universal access to reproductive health (11,12).

After the MDGs era, the Sustainable Development Goals (SDGs) were created in 2012 at the conference of the UN on sustainable developments in Rio de Janeiro (13). The SDGs replaced the MDGs. The SDGs are a call for action to promote prosperity to achieve a better and more sustainable future for all by all the countries. The seventeen goals are interconnected and to be achieved by 2030 (14). The goal number three (SDG 3) mainly focuses on achieving universal health coverage, with 13 targets, by ensuring good health and promoting well-being for all at all ages. Regarding maternal mortality, SDG 3 includes the target of achieving maternal death less than 70 per 100,000 live births, by working towards improvements in skilled delivery care (14).

1.3 Maternal mortality in Bangladesh

According to the United Nations Development Programme (UNDP), Bangladesh made tremendous progress in the reduction of MMR, along with some other areas (12). The country's first MDG report suggested that the ratio of maternal mortality was 574 per 100,000 live births in 1990. However, maternal mortality declined from 322 to 194 per 100,000 live births, over the period from 2001 to 2010, showing a remarkable 40% decline in these nine years, according to Bangladesh Maternal Mortality Surveys (BMMS) (12,15). To achieve the MDGs in 2015, the required average annual rate of maternal mortality reduction was 3%,

whereas Bangladesh managed to reduce the average reduction rate, form the base year, up to 3.3%. In addition, the overall mortality among the women of reproductive age in Bangladesh also declined consistently between 2001 and 2010, findings from BMMS 2001 and 2010 recommended (15). Moreover, the proportion of delivery by skilled birth attendance also increased from 5% in 1991 to 32% in 2011 (16).

In 2007, the Government of Bangladesh and the UN launched a programme called "Maternal and Neonatal Health Initiatives in Bangladesh" (MNHIB), which aimed at to reduce the disparities in maternal and neonatal mortality and morbidity. In order to implement the programme, United Nations Population Fund (UNFPA), United Nations Children's Fund (UNICEF) and WHO jointly worked with the Government of Bangladesh. The MNHIB programme was designed with a focus on reducing both the maternal and neonatal mortality and morbidity in Bangladesh. The programme was implemented in 2 stages, with the initiatives intending to raise awareness among the women about their rights to safe motherhood. Increasing health care utilization, improving access, participation, and accountability in both maternal and neonatal interventions were the most crucial outcomes of the programme (17).

According to a report by the WHO in 2010, Bangladesh was one of those eleven developing countries that accounted for about 65% of all the maternal deaths that occurred globally. In addition, MMR was also higher in Bangladesh (340/100,00 live births) in 2010, which was one of the highest mortality ratios in the world during that period (11,18). According to UNICEF, the MMR in Bangladesh had further reduced to 173 deaths per 100,000 live births in 2017, and the total number of maternal deaths was around 5100 in the same year (19).

1.4 Antenatal care visits and maternal mortality

Antenatal care (ANC) visits are the core component of the continuum of care for women during their pregnancy, which potentially contributes to the survival of both women and children (20). Being an essential part of basic health care during pregnancy, ANC visits can prevent, detect, and treat risk factors in the early period of pregnancy. Women, during their pregnancy period, were usually screened for pre-existing conditions and possible complications. This essential care service allowed women to get proper treatment at the appropriate time, while acting as a platform for women for receiving counselling as well, in

order to support women to protect their health and their baby during antenatal, birth, and the postnatal period (21). Furthermore, care and information, which are not directly related to pregnancy but help to minimize maternal risk factors, such as - information regarding healthy lifestyle or tackling malnutrition are also provided during ANC visits. Thus, ANC visits act and recognized as a potential determinant in reducing maternal mortality as well as child mortality and morbidity (20). Moreover, existing literature also supported the fact that utilization of maternal health services (MHS), such as antenatal care, prenatal care, and institutional delivery, had a significant correlation with the reductions in maternal mortality (22,23).

1.4.1 Antenatal care guideline

The WHO updated its ANC guidelines and launched new comprehensive recommendations, known as 2016 WHO ANC model on 7th November, 2016 (21,24). The new guidelines were based on the human-rights approach and prioritized person-centred care and well-being. The newly released WHO ANC model was previously known as Focused ANC (FANC) or basic ANC (BANC). The new guidelines followed a goal-oriented approach to delivering evidence-based care and interventions during four critical times of a pregnancy period. Furthermore, a positive pregnancy experience was considered as a key focus of the updated ANC guidelines (24).

According to the new ANC guideline, five types of interventions were recommended- nutritional interventions, maternal and foetal assessment, preventive measures, interventions for common psychological symptoms, and health system interventions to improve the utilization and quality of ANC (21). Nutritional interventions included dietary interventions, energy and protein dietary supplements, vitamins and minerals supplements. Maternal and foetal assessments involved complete blood test to diagnose anaemia during pregnancy, testing and counselling regarding human immunodeficiency virus (HIV), Symphysis-fundal height measurements for foetal growth measurements. Furthermore, preventive measures comprised of anti-helminthic treatment, tetanus toxoid vaccination, along with other measures. Common psychological interventions included the treatment of heartburn, nausea-vomiting. Among the health system interventions, contact schedule and carrying own case notes of every pregnant woman were included (21).

The recent WHO ANC guidelines had used the word "contact" instead of "visits" since an active connection between the pregnant women and a health care provider is implicit, which does not imply with "visits"(21). As per the new guidelines, to reduce the perinatal mortality and improve women's experience of care, a minimum of eight contacts were recommended between pregnant women and the health care providers instead of four, which was previously recommended according to the FANC model (21). Among the eight contacts in the new guidelines, the first contact was suggested to be scheduled in the first trimester, which is up to 12 weeks of gestation, followed by 2 contacts in the second trimester- at 20 and 26 weeks of gestation and lastly, five contacts in the third trimester- at 30, 34, 36, 38 and 40 weeks of gestation (21). Unlike the FANC model, the new guidelines recommended an additional contact at 20 weeks of gestation and another three extra contacts in the third trimester since the antenatal risk for both mother and baby are greatest in this period (21).

1.4.2 Antenatal care coverage

ANC coverage is defined as the percentage of women, aged between 15 and 49 years, attending at least one antenatal visit with a skilled healthcare provider (i.e., doctor, nurse, or midwife) during pregnancy (25). A previous study suggested that the provision of ANC services increased during the last decade (20). Globally, the ANC coverage was approximately 85% during the period from 2010 to 2015, and in the least developed countries, the coverage was around 77% under the same period (20,26). According to the UNICEF 2019, only two in three pregnant women, which constitutes about 65%, receive four ANC visits worldwide, although 86% of the pregnant women have access to at least one ANC visit with the skilled health personnel (25). Furthermore, the lowest level of antenatal care was noticed in Sub-Saharan Africa and South Asia, whereas the percentage of women receiving at least four ANC visits are 52% and 49%, respectively (25).

Regarding the ANC coverage in Bangladesh, the BMMS claimed in 2016 that the utilization of key MHS was quite low in Bangladesh and only 37% of pregnant women attended at least 4 ANC contacts (27,28). BMMS also reported that the progress towards the reduction of maternal mortality stalled in Bangladesh, despite the impressive development in the past few decades (27).

1.5 Skilled delivery care and delivery practice in Bangladesh

As per WHO recommendation, skilled care is crucial to save the lives of both pregnant women and newborns before, during, and after the childbirth (8). However, the use of institutional delivery care in Bangladesh is quite low, especially in rural areas, in spite of the steady decline in MMR (29). Earlier studies suggested that approximately 71% of the total deliveries in Bangladesh occurred at home (30). On the other hand, only one in every five women attended skilled delivery health care facilities, according to an estimation in 2007 (31). This proportion was far below the target that was internationally set to 85% by 2010 and 90% by 2015 (32).

In Bangladesh, the home delivery practice was an old tradition, which was often assisted by unskilled birth attendants or relatives, without having any professional training (33). Studies previously reported that deliveries at home tended to be unsafe and unhygienic, compared to the institutional deliveries. Additionally, the coverage of essential newborn care was also inadequate at home birth (34). A previous study, conducted in rural areas of Bangladesh, showed that about one-third of the women experienced delivery-related complications during their last birth (35). In Bangladesh, one of the leading causes of maternal mortality was delivery-related complications (35).

The traditional birth attendants (TBAs) were found to be usually cheaper and easily available for the delivery services, especially in poor households in Bangladesh (36). However, the services provided by the TBAs are neither effective nor safe as compared to the services provided by the skilled health care providers. TBAs were usually not well-equipped and lacked appropriate technologies to manage any critical medical situation, such as- post-partum haemorrhage (36,37). The dependency on TBAs and less qualified health providers was higher, especially in rural areas, due to the fact that there was a shortage of healthcare professionals in Bangladesh as well (36). Moreover, even if the skilled healthcare facilities were available, the utilization of skilled care was still low and not adequate in Bangladesh. Lack of affordability, poor knowledge regarding maternal health, and TBAs being the comparatively cheaper and frequently available source of delivery services were the possible reasons behind the low uptake of skilled care (36).

According to the Maternal and Child Health expenditure report, provided by the World Bank in 2016, country's total expenditure on reproductive health was approximately 21.1 billion Bangladeshi Taka in the fiscal year 2012 in Bangladesh and almost 90% of the expenditure was allotted for the preventive care services (38). However, major expenses during the child delivery care depended on out-of-pocket (OOP) expenditure by the responsible households (39).

1.6 Determinants of place of delivery

Previous studies have highlighted factors that were associated with the choice for place of delivery. Several studies pointed out a range of demographic factors, such as – younger maternal age, marital status, low parity, high autonomy, utilization of ANC, husband's higher educational attainment, high-quality care perception and use of modern contraceptives (40–44), which were found to be influential to using the institutional services. Other than the demographic factors, socio-economic factors, such as - urban residence (45,46), household living conditions (47), women's working status (48), and household income or wealth index (49) appeared to be strong predictors of using institutional delivery services among women.

A study in Pakistan suggested that the household's wealth index and women's education had a significant association with institutional delivery (50). Another study in India reported that maternal age at birth appeared to be an important predictor of institutional delivery, whereas younger women were more likely to utilize health facilities than the older ones (51). A study conducted in Khartoum, Sudan considered the number of children and reported that the chance of home delivery increased accordingly when the number of children increased per woman (52). A study in North West Ethiopia reported that the husband's occupation and maternal knowledge regarding obstetrical danger signs of pregnancy and delivery had an impact on delivery at a health institution (53). In addition, existing pieces of literature in Pakistan and Northern Ghana took into account the mass media exposure as a significant predictor of institutional delivery and reported the influential effect of exposure to media on health facility delivery as well as the overall health services utilization in a community (54,55).

A study in Bangladesh suggested that maternal education and ANC visits were crucial predictors of institutional delivery (56). Few studies conducted in Bangladesh mentioned administrative region and religion as a significant determinant of institutional delivery (57,58). Another study done in Bangladesh considered having any family planning and being aware of community clinic services to be associated with the utilization of institutional delivery (36).

1.7 Justification

To minimize maternal mortality, utilization of maternal healthcare services, such as antenatal care and prenatal care, institutional delivery, were proven to be crucial (22,23). Therefore, the underlying factors that could both hinder or promote the utilization of institutional deliveries should be identified and addressed, to combating maternal morbidity and mortality. Moreover, the knowledge regarding the socio-demographic and healthcare-related factors of the place of delivery is still limited in Bangladesh (36). Thus, this study focused on addressing this knowledge gap and also to explore the factors associated with the place of delivery among the ever-married women of reproductive age in Bangladesh.

1.8 Aim

This study aimed at investigating the associations between the socio-demographic and healthcare-related factors, and the place of delivery among ever-married women of reproductive age in Bangladesh, using a dataset of a nationally representative survey in 2014.

1.9 Research question

What are the factors associated with the place of delivery among ever-married women of reproductive age in Bangladesh?

2 Methods

2.1 Study design

This was a cross-sectional study conducted by the secondary data analysis of the Bangladesh Demographic and Health Survey (BDHS) in 2014. It was a nationally representative survey that carried out from June 2014 to November 2014. To collect information about the respondents of this study, the survey followed the DHS women's questionnaire. Details about the survey questionnaires, study methodologies, findings of this survey have been described elsewhere (27).

In Bangladesh, the Demographic and Health Survey (DHS) program was implemented under the authority of the National Institute of Population Research and Training (NIPORT), Ministry of Health and Family Welfare. This survey was conducted by Mitra and Associates, a Bangladeshi research firm located in Dhaka and was funded by The United States Agency for International Development (USAID), Bangladesh. The technical assistance was provided by a USAID-funded project, ICF Internationals of Rockville, Maryland, USA throughout the DHS Programme (27). The survey planned to lay out the monitoring and evaluating needs in the health, population, and nutrition sector at the national level. Furthermore, the survey also provides information to the policymakers for planning and implementing future interventions in the respective sectors.

2.2 Study setting

2.2.1 Country profile

Bangladesh is situated in the South-east Asian region and has a total area of 147,570 square kilometres. Bangladesh shares border mostly with India to the west, north, and east and, with Myanmar to the southeast and the Bay of Bengal coastline to the south. It is a country of low, flat land with an extensive network of rivers across the whole country which is a significant hallmark of the terrain. The tropical climate of Bangladesh consists of a hot, humid summer, followed by relatively cooler monsoon seasons and dry, cool winter. Administratively, Bangladesh is divided into 7 divisions, 64 districts, and 545 *Upazila*s and *Thana*s. The official language is Bangla which is used nationally (27).

Map of Bangladesh   (Source: World Health Organization, 2020)

According to the WHO, the total population in Bangladesh was around 163 million in 2016 (59). In the report of Bangladesh Bureau of Statistics (BBS) in 2014, Bangladesh was the most densely populated country in the world, excluding the city-states Singapore, Bahrain, and Vatican. Bangladesh had a population density of 1,070 people per square kilometres in 2014. According to the BBS 2014, the majority of the population were Muslims (90%), followed by Hindus (9%) and other religions (1%). Moreover, life expectancy at birth was 71 years in Bangladesh on average. Women had a bit longer lifespan than men whereas life expectancy at birth in women and men was 72 years and 69 years respectively (27).

According to UNDP, the human development index (HDI) of Bangladesh belonged to the medium human development category and ranked 142 out of 188 of countries and territories in 2015. There was an annual increase of 1.64 percent in the HDI in Bangladesh between the period 1990 and 2014. Moreover, Bangladesh ranked fifth among the eight South Asian countries, based on the HDI value (27).

Bangladesh had robust growth in the gross domestic product (GDP), with 6.5 percent, in the fiscal year 2014-2015. Industry and agriculture were the two major sectors of the economy. In 2015, World Bank suggested Bangladesh as a lower middle-income country based on a new income classification of world economies (27).

2.2.2 Health system in Bangladesh

The health care delivery system is well organized in Bangladesh. The health system is mainly divided into 2 sectors - public and private. Generally, healthcare is provided through the community clinics, health and family welfare centres, *Upazila* health complexes, district-level hospitals, medical college hospitals at the tertiary levels, and specialized hospitals. Furthermore, private and non-government organizations (NGOs) also play a vital role in the provision of health care to the people of Bangladesh (60).

The public health sector is usually tax and donor-based, while the private sector is market-based (61). The public health system provides primary, secondary, and tertiary levels of health facilities, whereas the private health sector supplies secondary and tertiary level health facilities, mostly urban-based. For the majority of the rural population, the district healthcare system acts as the key healthcare service provider and a district health system comprised of public primary and, both public and private secondary health facilities. Moreover, the tertiary level hospitals act as the graduation and post-graduation training institution, besides serving the tertiary level healthcare facilities (61). A previous study in Bangladesh suggested that, Bangladesh had a serious shortage of human resource (61). It was one of the 57 countries of the world with human resource scarcity, whereas the doctor-population ratio was approximately 3:10,000 (61).

2.3 Study population and sample size

For 2014 DHS Bangladesh, initially, 17989 households were selected based on the population distribution in urban-rural areas and divisions. Among the selected households, 17300 households were interviewed and all the ever-married women of reproductive age, from 15 to 49 years old, from the households were considered eligible for the interview.

A total number of 17863 ever-married women of reproductive age were enrolled in the DHS survey and they delivered to a total number of 43772 births. For the current study, 39053 births were excluded due to system missing, and after removal of the missing data, the sample was reduced to 4719. Furthermore, the birth order was restricted to women's last childbirth for this study, and only the latest birth of each woman, 5 years preceding the survey, was considered. After the exclusion of the other births (n = 225), the sample size further reduced

to 4494. Finally, a sample size of 4487 women was available for the analysis of the present study, after exclusion of the missing information on the place of delivery (n = 7). Among these, a total of 2693 (60.0%) women gave birth by home deliveries and 1794 (40.0%) women gave birth by institutional deliveries (27).

2.4 Sampling design

A sample frame was used in the DHS 2014 survey based on the enumeration areas (EAs) of the 2011 population and housing census of the People's Republic of Bangladesh, which was conducted by the BBS. Primarily, the sampling unit for this survey is an EA, including 120 households on average (27).

Bangladesh is divided into seven administrative areas, namely Dhaka, Barisal, Khulna, Chattogram, Rajshahi, Sylhet, and Rangpur. Each division is divided into *Zilas* and each *Zila* is further divided into *Upazillas*. Each urban area consists of *Upazilas*, which is divided into *Wards*. Each *Ward* is then subdivided into *mohallas*. On the other hand, a rural area consists of *Upazilas*, which is divided into *Upazila Parisads*, including different *Mouzas*. To separate the whole country into urban and rural areas, these divisions are crucial (27).

For the sampling method, the BDHS-2014 used a two-stage stratified cluster sampling, based on the EAs and the households. For the first stage, 600 EAs were selected, among which 393 EAs in the rural and 207 EAs in the urban areas. In the second stage, each EA included 30 households on average as a systematic sample to provide statistically significant estimations of the key demographic and health variables for both as a whole the country as well as the urban and rural areas separately.

2.5 Data collection

The survey was carried out from June 28, 2014 to November 9, 2014. In the 2014 BDHS, three types of questionnaires were used- a household questionnaire, a women's questionnaire, and a community questionnaire. To collect the information about all the included ever-married women, aged 15-49 years, the DHS woman's questionnaire was used in the DHS survey. In order to conduct the interviews, a total number of 164 field workers were recruited

based on their experience, level of education, and interest in working. All the field workers were trained afterward to conduct oral interviews.

In the interviews, women were asked about several topics – their background characteristics, such as age, marital status, educational attainment, the place of residence, religion, media exposure and husband's background. They were also asked about reproductive behaviour and future childbearing intentions, knowledge, and use of contraception. Information on antenatal care, delivery care, postnatal care, breastfeeding practices, and child's health and nutrition were also included in the interviews. Women were asked about various aspects of women empowerment, including autonomy, decision making, and barriers to healthcare as well. The knowledge about Human Immunodeficiency Virus (HIV), sexually transmitted infections, along with some other topics, such as - behaviour related to environmental health, tobacco use and health insurance were also included.

The household response rates in both urban and rural areas were 97.2 percent and 98.2 percent, respectively. The individual response rate of the women was 97 percent in urban areas and 98.4 percent in rural areas (27).

2.6 Selected variables

2.6.1 Dependent variables

The dependent variable of this study was the place of delivery in Bangladesh. The outcome was made as a dichotomous variable and was classified into 2 broad categories- home delivery and institutional delivery. If the women gave birth at home, it was coded as "0", while, if the women gave birth at any health institution, it was coded as "1". Institutional delivery was the outcome of interest for this study. Furthermore, the institutional deliveries in Bangladesh included deliveries in both public and private sectors, including public and private hospitals, district hospitals, Maternal and child welfare centre (MCWC), *Upazila* (sub-district) health complex, *Upazila* health and family welfare centre, Community clinics, private clinics as well as clinics of NGOs.

2.6.2 Independent variables

The following independent variables were assessed for their association with the place of delivery. The choice was made according to the evidence of previous literature (36,53,57,58) and the availability of data.

Maternal age

This was the current age in completed years of the included ever-married women during the survey, giving birth to their last child. Initially, it was a numerical variable, which was turned into a categorical one. Maternal age was categorized into 3 broad groups, namely 15-24 years, 25-30 years, and 31-49 years. The youngest age group (15-24 years) was chosen as the reference category.

Place of residence

This was the place where the eligible women for this study resided and it was categorized as urban and rural, whereas urban was considered as the reference category for the analysis.

Religion

Religions of the included women were divided into 2 major groups – Islam and Other religions. Other religions included Hinduism, Buddhism, and Christianity, which were merged to make it one variable. For the analysis of the current study, the group "other religions" was considered as the reference category.

Maternal education

Educational attainment of the included women was categorized into six categories in the DHS survey - no education, incomplete primary education, complete primary education, incomplete secondary education, complete secondary education, and higher education. No education category was chosen as the reference category for the analysis.

Husband's education

The husband's education level was categorized into four categories – No education, primary education, secondary education, and higher education, while no education level being the reference category.

Wealth index

Wealth index represented the household socio-economic status and was collected based on the information of household asset ownership, using Principle Component Analysis. The wealth index was a categorical variable and included poor, middle, and rich quintiles. For the analysis of this study, the poorest and poorer category were merged and re-coded as the "poor" and, the richer and richest category were combined and turned into the "rich" category. The poor quintile was used as the reference category for the study.

Mother's current working status

The mother's current working status defined the current occupation of the included mothers. The current working status of the mothers was dichotomized as "Not working" and "Working" category. The reference category was the not working women.

Female autonomy in making a decision about women's health care

The autonomy of the eligible women was measured based on the fact that who made the decision about women's health care within a household. Female autonomy was categorized into 4 groups – wife alone, wife and husband, or partner together, husband or partner alone, and someone else from the household. The category "wife alone" was the reference category here for this study.

Counsel about danger signs during pregnancy

This was the information on counselling about the danger signs during pregnancy. If the mothers were not counselled about the danger signs of the pregnancy, it was categorized as "No". On the other hand, if the mother got counselling during their pregnancy, it was categorized as "Yes". The "No" category was the reference category here for this study.

Number of Antenatal care (ANC) visits during pregnancy

The respondents were asked about the total number of attended ANC visits during their pregnancy. The number of ANC visits was initially a numerical variable, which was turned into categorical one and was included as 4 major categories for this study - no ANC visit, 1-2 visits, 3-4 visits and, 5 or more visits. No visits category was considered as the reference category here.

2.7 Statistical methods

The IBM Statistical Package for Social Sciences (SPSS) software, version 24 was used for all the statistical analysis of this study.

2.7.1 Variable management

The Birth Recode (BR) file of DHS contains all the required variables, providing all the necessary information about the birth history of the included women. The Recode manual-7 was used to identify and manage the variables. Other unnecessary variables were deleted for easy access to the required ones. Cases with missing values were excluded and analysis was restricted to the only last birth given by the eligible women. The birth index one indicated the last childbirth of each woman. Finally, variables were re-coded and re-categorized when appropriate.

2.7.2 Descriptive statistics

A descriptive analysis was performed to see the frequency (percentage) of the included factors. Frequency (percentage) was used to explain the background characteristics of all the factors as well as the distribution of the outcome variable – the place of delivery.

2.7.3 Inferential statistics

Initially, a bivariate analysis was performed using Pearson's Chi-square ($\chi2$) test to determine the association between the selected factors and the place of delivery. For the multivariate analysis, logistic regressions were carried out in 2 different models - unadjusted and adjusted analyses. For the unadjusted analysis, a simple logistic regression was performed, whereas each factor was assessed separately to see their association with the outcome variable, and to calculate the unadjusted odds ratios (ORs). Furthermore, a multivariate binary logistic regression was performed to calculate the adjusted ORs for the adjusted analysis. More specifically, all the independent variables were included in a multivariate logistic regression model to determine the associations between the selected factors and the binary outcome – the place of delivery. The level of significance was set at p-value < 0.05 with a 95% confidence interval (CI) for Pearson's Chi-square test and both for the unadjusted and the adjusted ORs. In order to check multicollinearity between the independent variables, Variance Inflation Factor (VIF) was applied and no variables were found highly collinear.

2.8 Ethical consideration and principles

In order to protect the privacy of the respondents and the household members, the DHS program maintains strict rules in all the surveys. For standard DHS surveys, the procedures and questionnaires have been reviewed and approved by the Informed Consent Form (ICF), International Review Board (IRB). Besides, to protect the human subjects, ICF IRB also ensured that the survey fulfilled the U.S. Department of Health and Human Services regulations (45 CFR 46) (62). For BDHS 2014, the survey was implemented by Mitra and Associates, under the authorization of the NIPORT, Ministry of Health and Family Welfare, Bangladesh. The host country IRB ensured that the survey followed the laws and norms of the nation.

Prior to the conduction of the interviews, an informed consent statement was read to the respondents by a survey team member and the respondents had full rights to accept or decline to participate in the interviews. Emphasis was given in the consent statement that the respondent's participation was voluntary, with the right to withdraw at any time or not to answer any question, if they do not want to. Respondents were also informed about the confidentiality of their identity and the information they provided (62). Data from BDHS 2014 was accessed from the DHS website by obtaining approval to utilize the data for academic purposes.

3 Results

3.1 Participants

For the analysis, a sample size of 4487 women was available for the present study, after exclusion of the missing information on the place of delivery. Among these women, a total of 2693 (60.0%) women gave birth by home deliveries and 1794 (40.0%) women gave birth by institutional deliveries. The participants are illustrated in Figure 1.
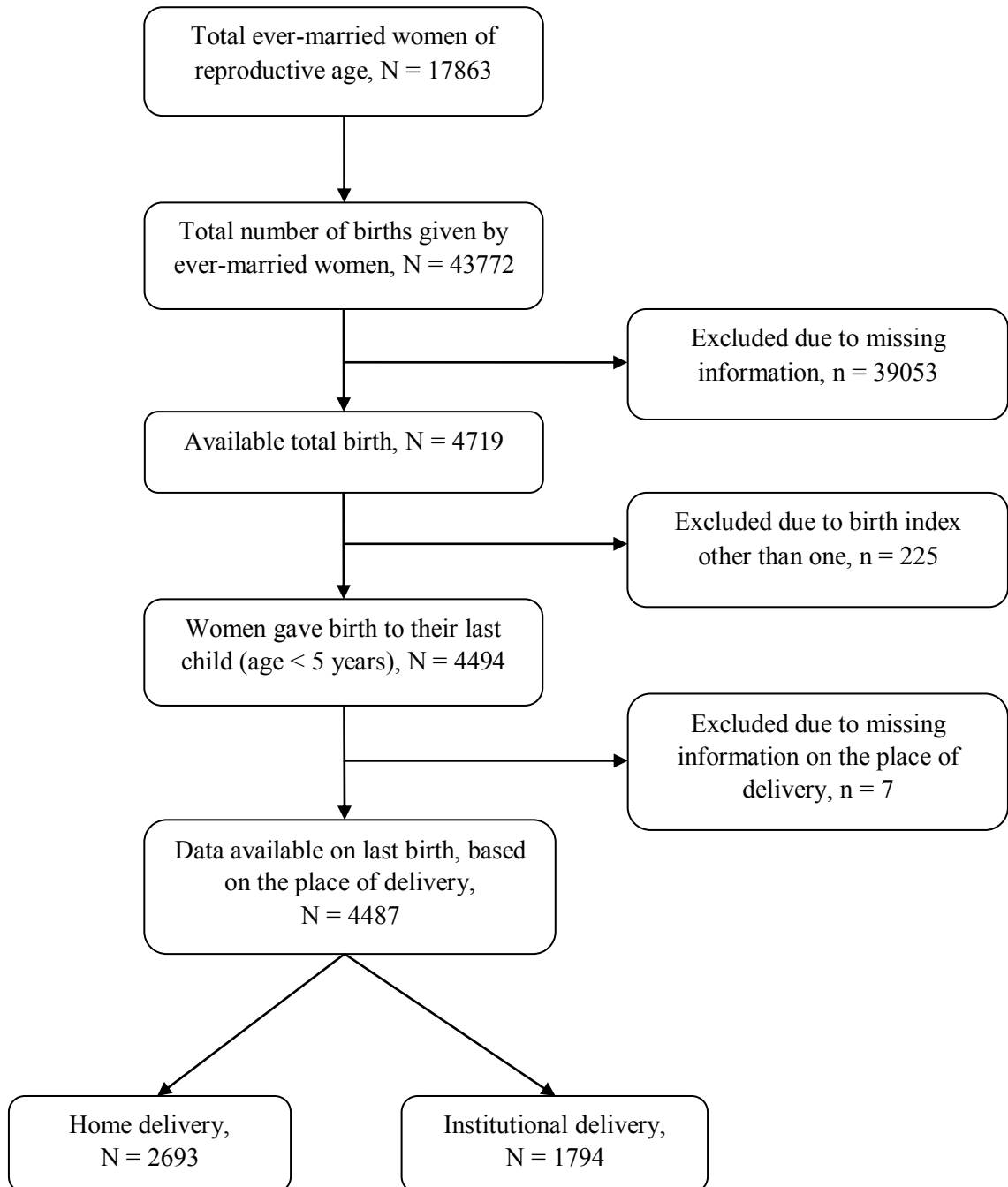
Figure 1: Flowchart illustrating the participants from the BDHS, 2014

3.2 Background characteristics of the study participants

Table 1 shows the background characteristics of the study participants. Among 4487 ever-married women included in this study, more than half of these women were from the younger age group (54.9%). In terms of place of residence, 67.7% of the women were living in rural areas and a vast majority (92.0%) of the respondents followed Islam as their religion.

Regarding maternal education, the highest percentage (40.1%) of women did not complete the secondary educational level. On the other hand, husbands of the included women in this study mostly attended secondary (31.5%) and primary (30.1%) educational level. It was noted that the respondents mainly belonged to the rich (40.9%) and the poor categories (40.0%) and the majority of the women (78.0%) were currently not working.

Table 1 Background characteristics of the selected factors (N = 4487)

Selected factors	Frequency, n (%)
Maternal age (years)	
15-24	2464 (54.9)
25-30	1319 (29.4)
31-49	704 (15.7)
Place of residence	
Urban	1448 (32.3)
Rural	3039 (67.7)
Religion	
Islam	4128 (92.0)
Other religions	359 (8.0)
Maternal education	
No education	607 (13.5)
Incomplete primary	707(15.8)
Complete primary	525 (11.7)
Incomplete secondary	1799 (40.1)
Complete secondary	327 (7.3)
Higher	522 (11.6)
Husband's education	
No education	1029 (22.9)
Primary	1352 (30.1)
Secondary	1414 (31.5)
Higher	690 (15.4)
Wealth index	
Poor	1793 (40.0)
Middle	858 (19.1)

Rich	1836 (40.9)
Mother's current working status	
Not working	3502 (78.0)
Working	983 (22.0)
Counsel about danger signs[1]	
No	1535 (43.6)
Yes	1988 (56.4)
Female autonomy[2]	
Wife alone	528 (11.9)
Wife and husband/partner together	2142 (48.4)
Husband/partner alone	1428 (32.2)
Someone else	331 (7.5)
ANC visits[3]	
No visit	963 (21.5)
1-2 visits	1470 (32.8)
3-4 visits	1103 (24.6)
5 or more visits	951 (21.2)
Place of delivery	
Home	2693 (60.0)
Institutional	1794 (40.0)

[1]Counsel about danger signs during pregnancy; [2]Female autonomy in making a decision about women's healthcare; [3]Total number of attended antenatal care (ANC) visits during pregnancy

Among the included women, 56.4% of women got counselling about the danger signs during their pregnancy. Regarding the female autonomy, in almost half (48.4%) of the cases, both wife, and husband or partner made the decision about women's healthcare. It was also observed that the women mostly had 1-2 ANC visits (32.8%) during their pregnancy (Table 1). Regarding the multicollinearity, there were no independent variables that were found highly collinear with each other. All the selected factors showed the VIF less than 1.6, which means that there is less chance of multicollinearity among the selected factors.

3.3 Bivariate analysis to evaluate associations between the background characteristics and the place of delivery, using Pearson's Chi-square test

The associations between the background characteristics and place of delivery, using Pearson's Chi-square test, were described in Table 2. Regarding the maternal age, the association between the maternal age and the place of delivery was found significant ($p < 0.05$). It was observed that among the women aged 31-49 years, 63.5% gave birth by home delivery, whereas 60.2% of women from the age group 15-24 years gave birth by home deliveries. Moreover, the difference between the home delivery and the institutional delivery was found higher in the age group between 31 to 49 years, followed by the youngest age group (15-24 years).

It was noted that the association between the place of residence and the institutional delivery was found significant ($p < 0.01$) and more urban women (57.7%) used the institutional delivery than rural (31.6%) women. Furthermore, it was also observed that religion was significantly associated with the place of delivery ($p = 0.01$), whereas the percentage of institutional delivery was higher in women of other religions (46.5%) than Islam (39.4%).

Regarding maternal education, there was a significant association between the maternal level of education and their place of delivery ($p < 0.01$). Among the women with no education, only 18.1% gave birth by institutional delivery, while among the women with higher education, 77.2% went for the institutional delivery. In terms of husband's education, the association between the levels of husband's education and place of delivery was found significant ($p < 0.01$). Women whose husband had higher education were more likely (72.0%) to give birth by institutional delivery, whereas only 20.5% of women, whose husband had no education, gave birth by institutional delivery.

It was noted that the association between wealth index and place of delivery was found significant ($p < 0.01$). More women from the rich (61.1%) wealth quintiles tend to give birth by the institutional delivery, whereas the majority of the women from poor (80.1%) households gave birth by home deliveries.

Table 2 Bivariate analysis to evaluate associations between the background characteristics and place of delivery, using Pearson's Chi-squared test (N = 4487)

Factors	Home delivery N (%)	Institutional delivery N (%)	P-value
Maternal age (years)			
15 - 24	1483 (60.2)	981 (39.8)	
25 - 30	763 (57.8)	556 (42.2)	< 0.05
31 - 49	447 (63.5)	257 (36.5)	
Place of residence			
Urban	613 (42.3)	835 (57.7)	< 0.01
Rural	2080 (68.4)	959 (31.6)	
Religion			
Islam	2501 (60.6)	1627 (39.4)	0.01
Other religions	192 (53.5)	167 (46.5)	
Maternal education			
No education	497 (81.9)	110 (18.1)	
Incomplete primary	528 (74.7)	179 (25.3)	
Complete primary	380 (72.4)	145 (27.6)	< 0.01
Incomplete secondary	1036 (57.6)	763 (42.4)	
Complete secondary	133 (40.7)	194 (59.3)	
Higher	119 (22.8)	403 (77.2)	
Husband's education			
No education	818 (79.5)	211 (20.5)	
Primary	939 (69.5)	413 (30.5)	< 0.01
Secondary	742 (52.5)	672 (47.5)	
Higher	193 (28.0)	497 (72.0)	
Wealth index			
Poor	1436 (80.1)	357 (19.9)	
Middle	543 (63.3)	315 (36.7)	< 0.01
Rich	714 (38.9)	1122 (61.1)	
Mother's current working status			
Not working	2034 (58.1)	1468 (41.9)	< 0.01
Working	658 (66.9)	325 (33.1)	
Female autonomy[1]			
Wife alone	310 (58.7)	218 (41.3)	
Wife and husband/partner together	1243 (58.0)	899 (42.0)	
Husband/partner alone	917 (64.2)	511 (35.8)	< 0.01
Someone else	188 (56.8)	143 (43.2)	
Counsel about danger signs[2]			
No	882 (57.5)	653 (42.5)	< 0.01

Yes	947 (47.6)	1041 (52.4)	
ANC visits[3]			
No visit	863 (89.6)	100 (10.4)	
1 - 2 visits	959 (65.2)	511 (34.8)	< 0.01
3 - 4 visits	537 (48.7)	566 (51.3)	
5 or more visits	334 (35.1)	617 (64.9)	

[1]Female autonomy in making a decision about women's healthcare; [2] Counsel about danger signs during pregnancy; [3]Total number of attended antenatal care (ANC) visits during pregnancy

It was also found that the association between women's current working status and the place of delivery was found statistically significant ($p < 0.01$). The higher percentage of working women (66.9%) gave birth by the home deliveries than those who were not working (58.1%) and the difference between home delivery and institutional delivery was higher among the women who were currently working.

The association between female autonomy in making a decision about women's healthcare and institutional delivery was also found statistically significant ($p < 0.01$). It was noted that when someone else from the households had autonomy, 43.2% of women gave birth by institutional deliveries, whereas when the wife alone had the autonomy, 41.3% of women gave birth by institutional deliveries. Furthermore, among women whose husband or partner decided alone about their health institution utilization, only 35.8% of those gave birth to any health institution.

The association between the counsel about danger signs during pregnancy and the institutional delivery was found significant ($p < 0.01$). It was observed that women who got counselling about the danger signs during their pregnancy were more likely (52.4%) to give birth at any health institution, compared to the women who did not get counselling (42.5%) about the danger signs when they were pregnant.

It was observed that the total number of ANC visits during the pregnancy and the place of delivery were found significantly associated ($p < 0.01$). Among the women who attended 5 or more ANC visits, 64.9% of those gave birth by institutional deliveries, while among women having no ANC visits during their pregnancy, 89.6% of those gave birth by home deliveries.

3.4 Associations between the selected factors and the institutional delivery

Associations between the selected factors and the institutional delivery are shown in Table 3. As shown in Table 3, the association between the maternal age and the institutional delivery was found significant among the age group (31- 49) years in unadjusted analysis, compared to the women in the reference category (age group 15-24 years). Women in the age group 31-49 years had 27% higher odds of institutional delivery (OR 1.27, CI: 1.05 − 1.53) in the unadjusted analysis. However, in the adjusted analysis, maternal age did not appear to be significantly associated with the institutional delivery in any of the age groups.

Place of residence showed a significant association with the institutional delivery in both unadjusted and adjusted analyses. More specifically, women from rural areas, compared to the women in urban areas, had 66% decreased chance of giving birth at any institution in unadjusted analysis (OR 0.34, CI: 0.30 − 0.39), whereas in the adjusted analysis, rural women, compared to their counterparts, were 38% less likely to deliver at any medical institution (OR 0.62, CI: 0.52 − 0.73).

Religion was also found significantly associated with the institutional delivery in both unadjusted and adjusted analyses. Women who had Islam as their religion, compared to the women of other religions, were 25% less likely to give birth by institutional deliveries (OR 0.75, CI: 0.60 − 0.93) in the unadjusted analysis. In the adjusted analysis, women of the Islam religion were 26% less likely to give birth by institutional deliveries (OR 0.74, CI: 0.56 − 0.98) as compared to the women of other religions.

In unadjusted analysis, compared to the women having no education, women from incomplete primary educational level had 53% higher odds of institutional delivery (OR 1.53, CI: 1.17 − 2.00) and women who completed primary education level showed 72% higher odds of institutional delivery (OR 1.72, OR: 1.30 − 2.29), although these results did not remain significant in the adjusted analysis. Furthermore, in the unadjusted analysis, maternal educational levels- incomplete secondary (OR 3.33, CI: 2.65 − 4.17), complete secondary (OR 6.59, CI: 4.87 − 8.92) and higher (OR 15.30, CI: 11.44 -20.46) also showed an increased likelihood of institutional deliveries. The ORs in other categories also increased with the levels of maternal education, accordingly. Results found in the adjusted analysis suggested that women who had higher education had more than 3 times higher (OR 3.18, CI: 2.12 −

4.77) chance of institutional delivery, compared to women who had no education. Moreover, women who had incomplete secondary and complete secondary education level had 1.5 times (OR 1.55, CI: 1.13 – 2.13) and almost 2 times (OR 1.98, CI: 1.33 – 2.96) higher chance of institutional deliveries, respectively, in comparison to the women having no education, in the adjusted analysis.

Table 3. Logistic regression models to evaluate associations between the selected factors and the institutional delivery in the current study, using 2014 Bangladesh Demographic and Health Survey (N = 4487)

Factors	Unadjusted			Adjusted		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Maternal age (year)						
15 - 24	1 (Ref)			1 (Ref)		
25 - 30	1.15	0.97 – 1.37	0.11	1.08	0.91 – 1.28	0.39
31 - 49	1.27	1.05 – 1.53	0.01	1.05	0.83 – 1.33	0.67
Place of residence						
Urban	1 (Ref)			1 (Ref)		
Rural	0.34	0.30 – 0.39	< 0.01	0.62	0.52 – 0.73	< 0.01
Religion						
Other religion	1 (Ref)			1 (Ref)		
Islam	0.75	0.60 – 0.93	0.01	0.74	0.56 – 0.98	0.03
Maternal education						
No education	1 (Ref)			1 (Ref)		
Incomplete primary	1.53	1.17 – 2.00	<0.01	1.26	0.90 – 1.78	0.18
Complete primary	1.72	1.30 – 2.29	< 0.01	1.31	0.91 – 1.87	0.15
Incomplete secondary	3.33	2.65 – 4.17	< 0.01	1.55	1.13 – 2.13	0.01
Complete secondary	6.59	4.87 – 8.92	< 0.01	1.98	1.33 – 2.96	<0.01
Higher	15.30	11.44 -20.46	< 0.01	3.18	2.12 – 4.77	< 0.01
Husband's education						
No education	1 (Ref)			1 (Ref)		
Primary	1.71	1.41 – 2.06	< 0.01	1.36	1.07 – 1.73	0.01
Secondary	3.51	2.92 – 4.22	< 0.01	1.57	1.22 – 2.01	< 0.01
Higher	9.98	7.97-12.50	< 0.01	2.34	1.70 – 3.22	< 0.01
Wealth index						
Poor	1 (Ref)			1 (Ref)		
Middle	2.33	1.95 – 2.80	< 0.01	1.54	1.24 – 1.91	< 0.01
Rich	6.32	5.45 – 7.34	< 0.01	2.32	1.90 – 2.84	< 0.01

Mother's current working status						
Not working	1 (Ref)			1 (Ref)		
Working	0.68	0.59 – 0.79	< 0.01	0.76	0.63 – 0.92	<0.01
Female autonomy[1]						
Wife alone	1 (Ref)			1 (Ref)		
Wife and husband/partner together	1.03	0.85 – 1.25	0.78	1.20	0.95 – 1.52	0.13
Husband/partner alone	0.79	0.65 – 0.97	0.03	1.14	0.89 – 1.47	0.30
Someone else	1.08	0.82 – 1.43	0.58	1.06	0.76 – 1.49	0.72
Counsel about danger signs[2]						
No	1 (Ref)			1 (Ref)		
Yes	1.49	1.30 – 1.70	< 0.01	1.20	1.03 – 1.39	0.02
ANC visits[3]						
No visit	1 (Ref)			1 (Ref)		
1 - 2 visits	4.60	3.64 -5.81	< 0.01	1.52	1.28 – 1.82	< 0.01
3 - 4 visits	9.10	7.17-11.54	< 0.01	2.12	1.75 – 2.56	< 0.01
5 or more visits	15.94	12.46-20.39	< 0.01	2.96	2.72 – 3.53	< 0.01

OR= Odds ratio; CI= Confidence interval; Ref= Reference category; [1] Female autonomy in making a decision about women's healthcare; [2] Counsel about danger signs during pregnancy; [3] Total number of attended antenatal care (ANC) visits during pregnancy

The husband's education (primary or above) appeared as a significant factor to be associated with the place of delivery in both unadjusted and adjusted analyses. With the increase in the levels of educational attainment of the husbands, there was an increased likelihood of giving birth by institutional deliveries by their wives in both the unadjusted and the adjusted analyses. More specifically, the husbands having higher education, compared to the husbands having no education, showed almost 10 times higher odds of institutional delivery (OR 9.98, CI: 7.97-12.50) in unadjusted analysis. Furthermore, in the adjusted analysis, women whose husbands had higher education showed more than 2 times higher odds of institutional delivery (OR 2.34, CI: 1.70 – 3.22) as compared to the husbands without formal education. Besides, women whose husbands attended the primary and the secondary educational levels also showed 1.4 times (OR 1.36, CI: 1.07 – 1.73) and more than 1.5 times (OR 1.57, CI: 1.22 – 2.01) higher chance of institutional delivery in the adjusted analysis, compared to those whose husbands had no formal education.

Women from middle and rich wealth index categories appeared to be significantly associated with institutional deliveries both in the unadjusted and the adjusted analyses. More specifically, women who belonged to the middle and rich wealth index, showed more than 2 times (OR 2.33, CI: 1.95 – 2.80) and more than 6 times (OR 6.32, CI: 5.45 – 7.34), respectively, higher odds of giving birth by institutional deliveries as compared to women from poor wealth quintile in the unadjusted analysis. In the adjusted analysis, women from middle and rich wealth index, compared to women from poor category, had more than 1.5 times (OR 1.54; CI: 1.24 – 1.91) and more than 2 times (OR 2.32, CI: 1.90 – 2.84) higher chances of institutional deliveries, respectively.

Women's current working status also found significantly associated with the place of delivery in both unadjusted and adjusted analyses. Compared to the not-working women, women who were currently working were 32% less likely to give birth by institutional delivery (OR 0.68, CI: 0.59 – 0.79) in the unadjusted analysis, whereas in the adjusted analysis, women who were currently working were 24% less likely to delivery at an institution (OR 0.76, CI: 0.63 – 0.92), compared to the not-working women.

The results of this study indicated that women who received counselling about the danger signs during the pregnancy period had a significant association with the place of delivery in both the unadjusted and the adjusted analyses. More specifically, women who got counselling during their pregnancy, compared to those who did not, had higher odds of institutional delivery both in the unadjusted analysis (OR 1.49, CI: 1.30 – 1.70) and adjusted analysis (OR 1.20, CI: 1.03 – 1.39).

In terms of the total number of attended ANC visits during pregnancy, it was observed that attending at least one or more ANC visits during pregnancy was significantly associated with institutional delivery both in the unadjusted and adjusted analysis and the ORs increased accordingly with an increase in the total number of ANC visits in both analyses. In the unadjusted analysis, women who attended 5 or more ANC visits, compared to those with no visit, had almost 16% higher odds of institutional deliveries (OR 15.94, CI: 12.46-20.39). In adjusted analysis, women who had 5 or more ANC visits during their pregnancy, had almost 3 times higher odds of institutional deliveries (OR 2.96, CI: 2.72 – 3.53) as compared to women who had no ANC visits. Furthermore, in the adjusted analysis, women who had (3-4) visits and (1-2) visits had more than 2 times (OR 2.12, CI: 1.75 – 2.56) and 1.5 times (1.52, CI: 1.28

– 1.82) higher chances of institutional deliveries, respectively, compared to women who had no ANC visits.

Female autonomy in making a decision about women's health care was found significantly associated with the institutional delivery when the husband or partner took the decision alone in the unadjusted analysis. It means that there was 21% less chance of institutional deliveries when the husband or partner made the decision (OR 0.79, CI: 0.65 – 0.97), compared to when the wife was responsible alone to make the decision about their healthcare. However, female autonomy in deciding about women's healthcare did not appear significant in the adjusted analysis.

4 Discussions

4.1 Key findings

This study aimed at investigating the associations between the socio-demographic and healthcare-related factors, and the place of delivery among ever-married women of reproductive age in Bangladesh. The key findings of this study depicted that the secondary and higher levels of maternal education, and primary and above levels of husband's education were found to be associated with the increased likelihood of the institutional delivery among these women. Women who belonged to higher wealth index backgrounds, received counselling about danger signs during their pregnancy, and attended at least one or more ANC visits while being pregnant also showed increased chances of giving birth at any health institution.

Women living in rural areas and from the Islam religion were less likely to deliver at health institutions. Mothers who were currently working had less chance of giving birth by institutional deliveries. However, the factors - maternal age and female autonomy in making a decision about women's healthcare were found to have no significant association with the place of delivery among ever-married women in Bangladesh.

4.2 Findings in relation to other studies

Similar to several other studies that were conducted elsewhere (57,63–65), the place of residence was found to be a significant indicator of the place of delivery. The current study showed that rural women were less likely to deliver at a health institution as compared to the women residing in urban areas. Another study in Guatemala (66) explained that this might be due to the lack of social support from the healthcare personnel, in comparison to the traditional midwives, who were considered to provide more compassionate care in rural Guatemala. The previous study in Bangladesh (58) also suggested that the provision of healthcare facilities was limited in rural areas and, rural women, being the disadvantaged ones, often lacked reliable transportation to the health facilities for deliveries. Another study in Bangladesh (57) found that urban women had more chances of delivering at a health institution than their counterparts (OR 1.48). The study mentioned that the dissimilarity in the utilization of healthcare services among the urban and rural communities might have arisen

due to the availability and quality of health services along with the access to healthcare facilities (57).

In accordance with the other studies in Bangladesh (57,58), this study identified that women from Islam religion were less likely to deliver at any medical institution than women of other religions. A study in Bangladesh explained the reason behind the women of Islam religion used less institutional delivery facilities and mentioned that it might be due to their conservative manners (57). Another study (58) mentioned that traditional beliefs, cultural norms along with some other factors might attribute to the fact. Furthermore, a previous study also suggested that women, who were Muslim and followed Islam religion tended to give birth at home and this fact was applicable not only for Bangladesh but also for all other women following Islam religion all over the world (58).

It was widely asserted that maternal education act as a strong predictor of institutional delivery. Consistent with the other studies in Bangladesh and elsewhere (58,67–70), this study results revealed that maternal education significantly influenced institutional delivery. It was found that women, who attended secondary or higher levels of education, were more likely to give birth by institutional delivery than those with no education. Other studies in Nepal (71) and Ethiopia (72) suggested that there was a strong association between maternal education and receipt of skilled assistance and delivery care. A study in Nigeria (73) mentioned that formal education could be influential in the utilization of institutional delivery in many ways. The fact that the probability of institutional delivery increased with the level of education could be due to the reason that education increased the health awareness, which in turn might raise a concern about the health facilities provided at the health institutions (67). A recent study in Bangladesh reported that educated women had a better understanding of healthcare-related messages provided by the mass media, such as- newspapers, billboards, and other types of media (57). A study conducted in Ethiopia (72) explained that low levels of education and lack of health knowledge were correlated with the existing traditional beliefs in pregnancy and childbirth in the country, which was responsible for the low uptake of skilled assistance during the pregnancy among the women with no education. On average, formal education challenged the healthcare-seeking behaviour of women and also transformed their point of view to more safe delivery (72).

Husband's education was one of the significant predisposing factors of institutional delivery. This study showed that women, whose husbands attended primary or above educational levels, were more likely to give birth at any health institution as compared to women, whose husbands had no formal education. This finding was in line with the other studies conducted in Bangladesh, Ethiopia and Nigeria (58,70,74). The potential explanation of this fact could be that education might make the husbands more open-minded towards the medicines available at present-days and also more conscious about the advantages of giving birth at the health institutions. Moreover, educated husbands also facilitated the care-seeking behaviour of women by not putting constraints over their wives' flexibility as well as decision-making power (70).

In accordance with the other studies (57,75,76), this study reported that the household wealth index of the included women acted as a strong influencing factor on institutional delivery. Similar to the previous studies (7,57,58,77,78), this study found that women belonging to the higher wealth quintiles were more likely to give birth by institutional deliveries as compared to those from poor wealth quintiles. A study in Bangladesh (57) found that the wealthier women had 3 times higher odds of institutional delivery than women from the poor socio-economic strata (OR 3.15). Another study in Bangladesh (58) pointed out that this might be due to the fact that the richer had the wherewithal of paying the private care expenses and possessed the perception of receiving better quality at the private health institutions. In addition to that, the richer, with the increasing household income, might have easy access to the healthcare facilities, particularly at the private ones. At the private health institutions, quality of care was usually considered much improved than the public health facilities, which usually lacked skilled healthcare personnel, quality of care and adequate supply of necessary drugs (58). A conclusion can be drawn from this finding that the economic resources available to an individual positively influenced the delivery of a woman at an institution (57).

This study found that women's current working status was significantly associated with the place of delivery. However, strikingly, this study showed that women who were currently working were less likely to deliver at a health institution as compared to those who were currently not working, a finding which is contrary to expectation. A previous study (48) reported that women who were currently working or had employment showed higher odds of institutional delivery. Other authors (79) speculated that the better use of MHS was associated with the improvement in the economic status. Contrary to the finding of the current study, a

study conducted in Bangladesh (58) reported that women's working status was not significantly associated with child delivery at medical institutions. Another study in Bangladesh (36) also took into account women's working status as employment (categorized as yes/ no) and found it to be not significant in the Chi-square test, thus excluded for the regression analysis.

The current study showed that counsel about danger signs during pregnancy had a significant positive influence on the use of institutional delivery. The likelihood of utilization of institutional delivery was higher among women who got counselling during their pregnancy than those who did not. This result appeared to be consistent with the most studies done elsewhere (2,5,53,80,81). A study in North West Ethiopia (53) reported that women who had knowledge of obstetric danger signs were more likely to give birth at health institutions, compared to those who had no knowledge (OR 7.2). This might be due to the fact that the fear of complications was greater in respondents having knowledge about the danger signs, which made them seek skilled assistance during delivery (53). Another study in Eritrea (2) mentioned that women who were knowledgeable about the possible complications during pregnancy were more plausible to give birth by institutional deliveries than those who did not have enough knowledge (OR 4.4). It was also explained that receiving more information during ANC visits might be helpful in order to identify the danger signs during pregnancy as well as its negative consequences while giving birth at home, unattended by skilled health personnel (5). This might made them give birth at the health institution.

This study found that women who attended at least one or more ANC visits during their pregnancy had higher odds of giving birth at any health institution than those with no or less ANC visits. This indicated that those women, who attended more ANC visits and delivered at the institutions, were more conscious and had more knowledge about the importance of safe delivery, which they obtained from counselling while attending ANC visits (57). These findings are consistent with several other studies done in other countries (69,82–84). A study in Bangladesh mentioned utilization of ANC services as a strong predictor of delivery at a health institution and women attending ANC visits were more likely to be informed about the possible dangers of home delivery (57).

The findings of this study showed that maternal age was not significantly associated with institutional delivery. This finding was in line with the previous studies in Southern Ethiopia (85), Northern Ethiopia (86) and Tanzania (7). This could be possibly due to the homogeneity of the included women (7) since more than half of the participants of this study were from the age group (15-24) years (54.9%) and a majority of the respondents were residing in rural areas (67.7%). This might have made it more difficult to explore such an association. Contrary to the finding of this study, several studies found maternal age as a significant predictor of institutional delivery (57,70,72,87). However, regarding maternal age, previous studies showed mixed results. Several studies reported that older women, compared to younger women, had a higher likelihood of delivery at an institution (57,72,88). Previous studies in Ethiopia (72,88) suggested that older women were more conscious about the availability and accessibility of institutional health facilities. Contrary to this finding, another study in Ethiopia found that women, aged less than 25 years were 3.3 times more likely to deliver within health facilities, compared to the mothers, aged 35 years and above (53). Several other studies, conducted in the other districts of Ethiopia, suggested that among the women aged 15-24 years the chance of giving birth by institutional delivery were 4 times higher as compared to the women aged above 35 years (70,87,89). This could be because of the fact that younger mothers expected to be educated and had better access to information, compared to older mothers (53).

The result of this study showed that female autonomy in making a decision about women's healthcare was not significantly associated with institutional delivery. This finding was in line with studies conducted in Ethiopia (85,89,90). Nevertheless, there was no possible explanation of why female autonomy appeared as a non-significant factor to the place of delivery. Contrary to the result of this study, several other studies conducted in Bangladesh and elsewhere (2,58,79,91), suggested the female autonomy as an important predictor of institutional delivery. A study in Bangladesh (58) mentioned that women with higher autonomy were more prone to give birth by institutional delivery since the low autonomy referred to the decision making power to man. In a patriarchal society, like in Bangladesh, the husband's ignorance along with the autonomy in the household could affect the utilization of maternal and child healthcare services (92,93). Although no category was found significant in the current study, the category when wife and husband, or partner together decided about the women's healthcare had higher odds of institutional delivery (OR 1.2). A study in Northwest Ethiopia (5) reported that women who decided jointly with their husbands were more likely to

give birth by institutional delivery than those when wife alone had the autonomy (OR 3.32). It was possibly due to the fact that a successful agreement could be made through communication between the husband and wife in order to make the right decision.

4.3 Internal validity

The results of this study had good interval validity as the DHS survey followed a standardized data collection procedure. Collection of data was conducted through the field team workers who were trained, practiced and monitored before the actual data collection process. Moreover, the DHS datasets are considered high-quality datasets, and adequately large sample size also limits the possibility of random errors. Furthermore, the questionnaires used in the DHS surveys are of good quality and are used worldwide in many countries.

4.4 External validity

As the DHS program states the data as nationally representative, the results found in this study should be able to generalize over the whole country. However, the generalizability of this study may not be applicable outside Bangladesh because of the differences among the health systems, maternal health care services and context of other countries.

4.5 Strengths and limitations

4.5.1 Strengths

The key strength of this study is that it used the DHS dataset which is an internationally recognized and population-based dataset, which is generally applied for public health research. The surveys conducted by the DHS program are considered to be nationally representative and are valid with high-quality data since the data was collected by a team of trained and experienced field workers. This has reduced the chance of making any mistakes in the datasets.

In addition to that, the adequate sample size might be considered as a another strength of this study, which helps to avoid the margin of errors and ensure reliability providing more precise

and accurate values. Lastly, the topic scrutinized is of high public health concern, as a cornerstone to achieve SDG 3.1 to reduce the maternal mortality by 2030.

4.5.2 Limitations

There were several limitations that should be considered in this study. Firstly, this study used data that was built on women's reports, based on their recall memories, which might give rise to recall bias while interpreting the results (58). The risk of recall bias was higher if the respondent women had more than one child and there was a chance of mixing the birth history of different children. The recoding of the variables could be another risk of bias, although the coding was done following other studies to avoid the risk of bias as much as possible. Furthermore, the selection of participants could be another bias. Woman in a household, who passed away, was not included in the study.

The secondary nature of the data could be another limitation that led to lack of control over variables selection and measurement and also restricted the study to investigate some other crucial and well-known variables such as – distance to the nearest health facilities, cost, attitudes of the service providers, waiting time to receive health services, which were found previously to be influential on deciding about to using the health facilities available at present-time (58). Moreover, the secondary data fact predates the analysis by several years.

Due to the fact that the data were cross-sectional in nature, the study design makes it impossible to ascertain causation between the independent variables and the outcome measures, rather than just analyzing the associations between the factors. In addition, the result was not adjusted by the current age of the children, delivered by the women included in this study. Lastly, the results were not adjusted for the clustering sample design of data collection, which may give rise to type - 1 error. Due to the complex sampling model, the associations that were found significant in this study might not be significant.

4.6 Conclusions and recommendations

In conclusion, this thesis study revealed that the socio-demographic and healthcare-related factors were associated with the place of delivery among ever-married women of reproductive age in Bangladesh. Women who attended secondary or higher educational levels, belonged to the higher wealth index backgrounds and whose husbands attended primary or above education levels were found to be positively associated with the institutional delivery. During pregnancy, receiving counselling about danger signs and attending at least one or more ANC visits were also found to have positive impact on the institutional delivery. Conversely, women living in rural areas, from the Islam religion and those who were currently working showed negative associations with the institutional delivery.

To improve maternal health, and to minimize maternal mortality in Bangladesh, the provision of education to both women and their husbands should be a major focus, since education had a significant influence on the utilization of institutional delivery. Emphasis should be given on to the promotion and expansion of the coverage of ANC visits. To provide knowledge about the possible danger signs during pregnancy among the women of reproductive age is also recommended. Lastly, access to institutional deliveries should be increased, especially for the women who are socio-economically disadvantaged, uneducated, and living in rural areas.

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