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An empirical analysis of socioeconomic risk factors associated with antenatal care attendance in Bangladesh

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Abstract Maternal mortality and morbidity reduction constitute policy priorities, facilitated by prenatal care and World Health Organization (WHO)-endorsed antenatal care (ANC) utilization during pregnancy. Progress in Bangladesh is hindered as only 47% of expectant women participated in a minimum of four ANC sessions according to the latest maternal mortality survey. This study, utilizing 2018 Bangladesh Demographic and Health Survey (BDHS) data, undertakes an assessment of the socioeconomic determinants influencing the utilization or non-utilization of ANC services. Additionally, the study investigates socioeconomic factors significantly impacting the attainment of the WHO-recommended four or more ANC sessions. A Hurdle Negative Binomial Model is employed to ascertain ANC risk variables and their frequency, while the utilization characteristics of WHO ANC services are discerned through the Binary Logistic Regression Model. Noteworthy among the statistically significant determinants influencing the reception of any antenatal care (ANC) in Bangladesh are the sex of the household head, place of residence, wealth index, husband/partner's education, the highest educational attainment of women, decision-making regarding the expenditure of women's earnings, ease of obtaining medical assistance permission, mobile phone ownership, and media exposure. Furthermore, this empirical inquiry reveals that income inequality, the highest educational attainment of women, decision-making regarding the expenditure of women's earnings, distance to health facilities, mobile phone ownership, utilization of phones for financial transactions, and media exposure significantly determine adherence to WHO-recommended ANC guidelines. This study identifies four crucial determinants for the initiation of ANC services and adherence to recommended prenatal care: a pregnant woman's wealth index ranking, highest educational attainment, ownership of a mobile phone, and exposure to media. The findings of this study can aid Bangladeshi healthcare programmers and policymakers in devising strategies to achieve comprehensive ANC coverage for all pregnant women.

Keywords: ANC, Hurdle Negative Binomial Model, BDHS, Logistic Regression Model, Bangladesh

1. Introduction

Pregnancy and delivery problems kill 300,000 women globally each year. Most of these deaths are avoidable and occur in low-resource settings (Tunçalp et al 2017). One-third of global maternal and neonatal fatalities occur in South Asia (Victora et al 2016). According to Sustainable Development Goal 3, the worldwide agenda for Women's, Children's, and Adolescents' Health seeks to lower the maternal mortality ratio (MMR) to 70 per 100,000 live births and the neonatal mortality rate to 12 per 1,000 by 2030 (*Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development* 2017). Comprehensive, high-quality antenatal care (ANC) can help reduce maternal and child mortality and meet global and national maternal and child health targets (Benova et al 2018; Phommachanh et al 2019; Thaddeus & Maine 1994). A study based on DHS surveys conducted in Ethiopia in 2000 2005, and 2011 determined that living in an urban location, having a high level of education, and residing in the wealthiest families positively influenced the usage of antenatal care (Yesuf and Calderon-Margalit 2013).

To assess the important socioeconomic and demographic determinants impacting the adoption of antenatal care services in Ghana, Nketiah-Amponsah et al (2013) utilized the most recent GDHS data. This was accomplished using the negative binomial regression model. According to the study, the level of wealth, age, health insurance coverage (especially for rural women), educational attainment, birth order, religion, and geographical area of residency are major antecedents of the frequency of antenatal care service utilization. Using data from the 2011 Nepal Demographic and Health Survey, a research investigation was carried out to identify the factors associated with prenatal care utilization and quality (Joshi et al 2014). Age, parity, women's greater level of education, women's active participation in decision making, and partner's degree of education are predictors of four or more ANC visits, according to the research. Mugo et al (2015) analysed the 2010 South

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Sudan Demographic and Health Survey to assess the incidence and risk factors for the nonuse of visits to receive prenatal care. Using simple and multivariate logistic regression analyses adjusted for cluster sample survey design, the investigators determined that geographic region, husband's polygamy status, mother's literacy, and knowledge of the danger symptoms of newborns were significantly linked to not using ANC. In Nigeria, the absence of antenatal care varied substantially based on respondents' socioeconomic background, educational outcomes, place of residence, age, and relationship status (Fagbamigbe and Idemudia 2015). Saad-Haddad et al (2016) examined secondary analyses employing DHS data from seven Countdown countries, Bangladesh, Cambodia, Cameroon, Nepal, Peru, Senegal, and Uganda, to investigate prenatal care consumption patterns and factors. In the research, it was determined that women's education and household affluence were important predictors of beginning ANC and a higher frequency (4+) of visits. In their quantitative approach Ousman et al (2019) utilized a negative binomial regression model with random effects at the cluster level to model the number of ANC visits, whereas a multilevel binary logistic regression was used to model binary responses regarding whether a woman in Ethiopia had at least four ANC visits. At least four ANC visits were considerably fewer among women under the age of 20, living in rural regions, having a higher birth order, or who were Muslim. In contrast, higher levels of education, socioeconomic position, mass media exposure, and self-reported choice autonomy were substantially linked with at least four ANC visits. In the countries of sub-Saharan Africa, adequate ANC visits are significantly influenced by women's higher educational attainment, greater wealth status, employment, living in an urban area, exposure to the media, absence of barriers to accessing health facilities, proximity to health facilities, and ease of obtaining funds for treatment (Adedokun and Yaya 2020; Nisingizwe et al 2020; Rwabilimbo et al 2020).

Using 2004 Bangladesh Demographic and Health Survey (BDHS) data, a study was conducted to investigate the factors influencing the utilization of antenatal health care services in urban and rural areas. Analysis of logistic regression reveals that a mother's education, number of children, wealth index, disclosure of pregnancy difficulties, and authorization to visit a hospital or health center are major factors of obtaining antenatal care (ANC) (Rahman et al 2008). Amin et al (2010) compiled data from 3,498 randomly chosen married women from three household strata in 128 randomly selected remote villages in three divisions of Bangladesh in 2006 to identify the socioeconomic factors that distinguish maternal and infant health-seeking behavior in rural Bangladesh. They discovered that the utilization of ANC was significantly influenced by a higher wealth level, while the effects of education, age, and a woman's relative decision-making capacity were negligible. In Bangladesh, a community-based cross-sectional study was performed to determine the relationship between the utilization of prenatal care services and sociodemographic characteristics. In the investigation, logistic regression analysis revealed that the utilization of ANC is contingent on having a secondary education, having one live child, and having access to the media (Shahjahan et al 2013). Using multiple nationally representative Bangladesh Demographic Health Surveys and descriptive, inferential, and multivariate statistical techniques, the researchers determined that, in the context of Bangladesh, adequate utilization of ANC was positively associated with being married after the age of 18, having a secondary or higher level of education, coming from the wealthiest households, and residing in urban areas, partner's higher level of education and respondent’s participation in household decisions (Ali et al 2018; Bhowmik et al 2019; Rahman et al 2017; Rahman et al 2016). Bhowmik et al (2020) used the hurdle negative binomial regression model with cluster-specific random intercepts, which can account for overdispersion, zero-inflation, and intracluster correlation, to assess risk variables for ANC use and its prevalence in Bangladesh. Using BDHS 2014, the researchers determined that women with a low level of education, who reside in impoverished families, who have limited access to mass media, and who are from the Sylhet and Chittagong regions are less likely to use ANC and have fewer ANC visits. Pervin et al (2021) observed that while the first antenatal care visit was connected with women over the age of 30, infertility, husbands with more than 10 years of education, and being in the wealthiest quintile, none of these sociodemographic variables were related to four timely antenatal care visits. In Bangladesh, overdispersion and zero inflation in ANC adoption have been inadequately investigated. In addition, socioeconomic factors affecting ANC nonadherence in Bangladesh have received little attention. In Bangladesh, where only 47% of pregnant women receive WHO-recommended ANC services, there is room for research into socioeconomic factors that affect uptake.

One of the objectives of this study is to identify the risk factors for pregnant women in Bangladesh to receive ANC services. Using data from BDHS 2018, this study will also investigate the socioeconomic factors that significantly influence the use of four or more ANC services (WHO recommended).

2. Materials and Methods

2.1. Data description

This analysis uses nationally representative 2018 Bangladesh Demographic and Health Survey data (BDHS). The survey is based on a stratified sample of households selected in two stages. In the initial stage, 675 EAs (250 in urban regions and 425 in rural areas) were selected using a probability proportionate to the EA size. In the second step of sampling, a systematic sample of 30 families per EA was selected to give statistically credible estimates of key demographic and health characteristics for the country, urban and rural areas, and each of the eight divisions. This design chose 20,250 residential

households. A total of 20,100 ever-married 15-49-year-old women were interviewed. A total of 5051 married women who gave birth within three years of the study provided ANC visit data. Only the final birth was reported for mothers with two or more live births. Mothers were asked about their prenatal care and ANC visits. Recent literature on ANC utilization has explored several explanatory variables at the individual (woman), household, neighborhood, and regional levels. Individual-level explanatory variables in this study include Sex of household head, Residence, Wealth Index, Husband/partner's Education, Husband/partner's Occupation, Women's Highest Educational attainment, Women's Occupation, Decision on Expenditure of husband's earning, Decision on Expenditure of women's earning, Permission to have medical help, Getting money needed for treatment, Distance to health facility, Owns a mobile telephone and Media exposure (TV).

2.2. Model Selection

The bivariate relationship of the explanatory variables with the number of ANC visits was examined first by developing a simple PR model for each of the explanatory variables. The results are presented in Table 1. To develop strategies for enhancing maternal health care, policymakers, stakeholders, and donors should investigate risk factors for decreased prenatal care utilization or fewer visits. A proper count regression model for the number of ANC visits that includes multiple factors aids in the identification of these central risk factors. In this study, on the basis of the data set for n=5051, we have seen in Table 2 that the magnitudes of the AIC and BIC values obtained from the data are lowest for the hurdle negative binomial model. The residual deviance of the data is 8651.4 with 4952 degrees of freedom, which means that it has an overdispersion problem with a dispersion parameter of 1.74740. Our null hypothesis was that all models have equal effects on the data, in contrast to the alternative hypothesis that all models do not have equal effects on the data. In this empirical research, a hurdle negative binomial model was used to model the risk factors for ANC visits, and binary logistic regression was used to model binary responses relating to whether a woman had at least 4 ANC visits.

2.3. The hurdle negative binomial model

We consider a hurdle negative binomial (HNB) regression model in which the response variable Yi = (i = 1, 2, 3,. ... ... … ... ... , n) has the distribution (Fenta et al 2020):

$$P(Y_i = y_i) = \begin{cases} \pi_0, & \text{if } y_i = 0 \\ (1-\pi_0)\dfrac{\Gamma(y_i + 1/\alpha)(1+\alpha\mu_i)^{\frac{-1}{\alpha}}\left(1+\frac{1}{\alpha\mu_i}\right)^{-y_i}}{y_i!\,\Gamma\left(\frac{1}{\alpha}\right)\left(1-(1+\alpha\mu_i)^{\frac{-1}{\alpha}}\right)}, & 0 \le \pi_i \le 1 \\ & \text{if } y_i > 0 \end{cases} \quad (1)$$

where $\alpha \geq 0$ is a dispersion parameter that is assumed not to depend on covariates. In addition, we suppose $0 < \pi_0 < 1$ and $\pi_0 = \pi_0(Z_i)$. The most natural choice to model the probability of excess zeros is to use a logistic regression model:

$$logit(\pi_0) = \log\left(\frac{\pi_0}{1-\pi_0}\right) = \sum_{j=1}^{q} Z_{ij}\gamma_j \quad (2)$$

where $Z_i = (1, Z_{i1}, Z_{i2}, \ldots\ldots\ldots\ldots Z_{iq})$ is the ith row of covariate matrix Z and $\gamma = (\gamma_1, \gamma_2, \ldots\ldots\ldots \gamma_q)$ are unknown q-dimensional column vectors of parameters. Impact of covariates on count data is modelled through NB regression

$$\log(\mu_i) = \sum_{j=1}^{p} X_{ij}\beta_j \quad (3)$$

X_{ij} is the covariates, β is the coefficient of the independent variables in the regression model and p is the number of these independent variables. We can obtain the log-likelihood function for the hurdle negative binomial regression model as:

$$LL = \sum_{i=1}^{n}\{I_{y_i=0}\log(\pi_0) + I_{y_i>0}[\log(1-\pi_0) - \frac{1}{\alpha}\log(1-(1+\alpha\mu_i)) - logy_i! - y_i\log(1+\frac{1}{\alpha\mu_i}) - \frac{1}{\alpha}\log(\alpha\mu_i+1)+ \log(\frac{\Gamma(y_i+\frac{1}{\alpha})}{\Gamma(\frac{1}{\alpha})})]\} \quad (4)$$

2.4. Binary Logistic Regression Model

Bivariate analysis as simple summary statistics was used in this study to examine the significance of the association between dependent variables and selected explanatory variables at p<0.05. Pearson's chi-square (X2) test of independence for categorical dependent variables was utilized to determine the statistical significance. As the dependent variables were

categorical, binary logistic regression models were then implemented. These models were executed with variables that were statistically significant at the 5% level in bivariate analysis. The findings of the binary logistic regression analysis were presented using odds ratios (ORs) with 95% confidence intervals (CIs). All analyses were performed using the statistical package "R" 4.3.2. Table 1 exhibits the bivariate distribution of antenatal care (ANC)-seeking behavior of pregnant women. The distribution of the number of ANC visits shown in Figure 1 is positively skewed with the number of ANC visits. Approximately 8% of the pregnant women did not take any ANC visits, and only 47% took ANC at least 4 times during their pregnancy period.

Table 1 Bivariate Distribution of Antenatal Care (ANC)-Seeking Behavior of Pregnant Women.

		No ANC	ANC	ANC>=4		
Factors	Categories	N%	N%	N%	Chi-square	P value
Sex of household head	Male	361(7.30%)	4009(80.60%)	2100(42.2%)	0.162	0.379
	Female	47(0.90%)	557(11.20%)	276(5.5%)		
Residence	Urban	88(1.80%)	1612(32.40%)	993(20%)	31.411	0.000
	Rural	320(6.40%)	2954(59.40%)	1383(27.8%)		
Wealth Index	Poor	304(6.10%)	1786(35.90%	714(14.4%)	2.044	0.000
	Middle	56(1.10%)	846(17.00%)	430(8.6%)		
	Rich	48(1.00%)	1934(38.90%)	1232(24.8%)		
Husband/partner's Education	Educated	279(5.60%)	3941(79.20%)	2146(43.1%)	93.617	0.000
	Uneducated	129(2.60%)	625(12.60%)	230(4.6%)		
Husband/partner's Occupation	Have work	202(4.10%)	1773(35.60%)	924(18.6%)	17.842	0.000
	Do not Have work	206(4.10%)	2793(56.20%)	1452(29.2%)		
Women's Highest Educational Attainment	No Education	206(4.10%)	966(19.40%)	342(6.9%)	178.002	0.000
	Primary and Above	202(4.10%)	3600(72.40%)	2034(40.9%)		
Women's Occupation	Not working	206(4.10%)	2790(56.10%)	1449(29.1%)	17.614	0.000
	Working	202(4.10%)	1776(35.70%)	927(18.6%)		
Decision on women's health care	Woman Alone	27(0.60%)	344(7.00%)	171(3.5%)	0.422	0.330
	With husband/partner	263(5.40%)	2948(60.10%)	1581(32.2%)		
	Others	110(2.20%)	1216(24.80%)	598(12.2%)		
Decision on Expenditure of husband's earning	Women alone	14(0.30%)	107(2.20%)	50(1%)	10.919	0.000
	With Husband/partners	271(5.50%)	2765(56.30%)	1460(29.7%)		
	Others	115(2.30%)	1636(33.30%)	840(17.1%)		
Decision on Expenditure of women's earning	Women alone	46(3.30%)	451(32.00%)	255(18.1%)	0.892	0.198
	With Husband/partners	99(7.00%)	813(57.70%)	431(30.6%)		
	Others	0(0.00%)	0(0.00%)	0(0.00%)		
Permission to having medical help	Big problem	72(1.40%)	487(9.80%)	208(4.2%)	18.922	0.000
	Not a big problem	336(6.80%)	4079(82.00%)	2168(43.6%)		
Getting money needed for treatment	Big problem	251(5.00%)	1795(36.10%)	792(15.9%)	76.281	0.000
	Not a big problem	157(3.20%	2771(55.70%)	1584(31.8%)		
Distance to health facility	Big problem	219(4.40%)	1809(36.40%)	819(16.5%)	30.649	0.000
	Not a big problem	189(3.80%)	2757(55.40%)	1557(31.3%)		
Use phone for financial transactions	No	147(4.80%)	2512(82.50%)	1423(46.7%)	0.492	0.287
	Yes	18(0.60%)	368(12.10%)	235(7.7%)		
Owns a mobile telephone	No	243(4.90%)	1685(33.90%)	718(14.4%)	80.987	0.000
	Yes	165(3.30%)	2881(57.90%)	1658(33.3%)		
Media exposure (TV)	Not at all	284(5.70%)	1622(32.60%)	646(13%)	192.300	0.000
	Less than once a week	33(0.70%)	406(8.20%)	198(4%)		
	At least once a week	91(1.80%)	2538(51.00%)	1532(30.8%)		

Table 2 Comparison of different models in count data with AIC and BIC.

Model	Log Likelihood	AIC	BIC	SIC
Poisson	-11456.06	22992.13	23252.6	23252.6
Negative Binomial	-11137.67	22355.35	22615.82	22615.82
Zero-Inflated Poisson	-11286.65	22653.3	22913.78	22913.78
Zero-Inflated Negative Binomial	-11086.98	22253.97	22514.45	22514.45
Hurdle Poisson	-11286.56	22653.12	22913.6	22913.6
Hurdle Negative Binomial	-11083.38	22246.76	22507.24	22507.24

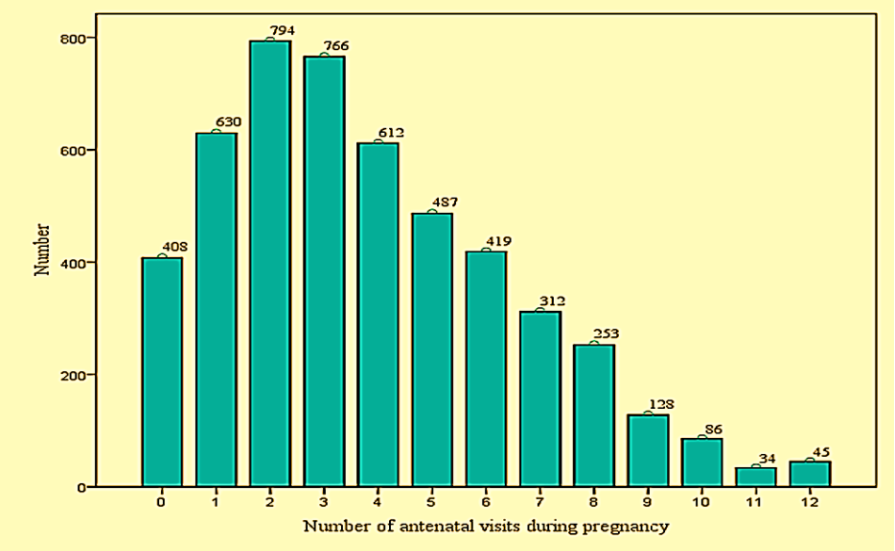

Figure 1 Distribution of the number of antenatal care (ANC) visits among pregnant women in Bangladesh according to the BDHS 2018 data.

3. Results

3.1. Risk factors associated with receiving any antenatal care (ANC) in Bangladesh

The magnitude of ANC receipt severity is demonstrated by the negative binomial component. In comparison to female household heads, a 7.4% increase in the rate of nonzero ANC receipt is observed among women aged 15-49 who had a live birth in the 3 years preceding the survey and belonged to a male-headed household. A 13.5% increment in the likelihood of nonzero ANC receipt is noted for women residing in urban areas compared to the aforementioned group living in rural areas. Relative to women belonging to the middle-income group in the wealth index, a 6.5% reduction in the rate of nonzero ANC is observed among women belonging to the poor income group, while an increase of 5.5% is seen for those in the rich income group. Women cohabiting with educated husbands or partners experience an elevated rate of nonzero ANC compared to those residing with uneducated husbands or partners. The rate of nonzero ANC receipt is 8.2% higher among women whose decision on earnings expenditure is made jointly with their husband/partner, in comparison to those made by others. Among women aged 15-49 who had a live birth in the 3 years preceding the survey, those with primary or higher level education witnessed a 22.6% increase in the rate of nonzero ANC receipt, in contrast to noneducated women.

The results also reveal that women who easily obtain permission for medical assistance enjoy a 12.5% higher rate of receiving nonzero ANC. Additionally, this empirical study observes that ownership of a mobile phone or media exposure less than once a week significantly increases the percentage of receiving nonzero ANC among women.

In this research, inconsistent findings are obtained in the zero-inflated hurdle negative binomial component, rendering it incapable of elucidating why 8% (only 408 out of 5051) of pregnant women in Bangladesh do not utilize ANC services. According to the 2014 BDHS survey, 22% of the 4493 ever-married women who gave birth in the three years preceding the study did not receive ANC during pregnancy, but this proportion decreased to 8% in the 2018 BDHS survey. The majority of the issues surrounding the avoidance of ANC uptake in Bangladesh have been satisfactorily addressed. Table 3 and Table 4 present the estimated regression coefficients (β) and odds ratios (OR) for ANC visits and nonattendance, along with their 95% confidence intervals and p-values, derived from the hurdle negative binomial regression in both the count and zero-part models.

3.2. Determinants of the WHO recommended ≥4 ANC contacts

Poor mothers are 48.4% less likely to obtain the WHO-recommended ANC contacts compared to mothers from wealthier homes. Additionally, mothers with no education are 40.6% less likely to have less than or equal to four ANC contacts than those with at least a primary school education. The odds of receiving the WHO recommended ANC contact among the women who take the Decision on Expenditure of husband's earnings alone were 0.491 times lower than those among the women who take the Decision on Expenditure of husband's earnings with others. The odds of receiving WHO-recommended ANC contact among mothers for whom the distance to a health facility is a major problem is 0.609 times lower than their counterpart. Women who do not utilize the telephone for financial transactions are 30.8% less likely to obtain fewer than or equal to four ANC contacts than those who do. Mothers who do not watch television are 58.6% less likely to obtain WHO-recommended ANC contact than mothers who watch television at least once a week. Table 5 shows the results of binary logistic regression to determine the factors influencing the WHO recommended ≥4 ANC contacts.

Table 3 The estimated regression coefficient (β) and odds ratio (OR) of having ANC visits with their 95% CI and p values from the hurdle negative binomial regression at count- part model.

		β	Std. Error	z value	Pr(>|z|)	OR	95% CI	
Factors	Intercept	0.916	0.113	8.074	0.000 ***	2.499	2.001	3.121
Sex of household head	Male	0.072	0.031	2.297	0.021 *	1.074	1.011	1.142
	Female	---	---	---	---	1.000	---	---
Residence	Urban	0.127	0.022	5.700	0.000 ***	1.135	1.087	1.186
	Rural	---	---	---	---	1.000	---	---
Wealth Index	Poor	-0.067	0.030	-2.232	0.025 *	0.935	0.882	0.992
	Middle	---	---	---	---	1.000	---	---
	Rich	0.057	0.028	2.002	0.045 *	1.058	1.001	1.119
Husband/partner's Education	Educated	---	---	---	---	1.000	---	---
	Uneducated	-0.110	0.035	-3.163	0.001 **	0.896	0.837	0.959
Husband/partner's Occupation	Have work	-0.210	0.326	-0.645	0.5190	0.810	0.428	1.534
	Do not Have work	---	---	---	---	1.000	---	---
Women's Highest Educational	No Education	---	---	---	---	1.000	---	---
	Primary and Above	0.204	0.028	7.278	0.000 ***	1.226	1.161	1.295
Women's Occupation	Not working	---	---	---	---	1.000	---	---
	Working	0.241	0.327	0.736	0.462	1.272	0.670	2.417
Decision on Expenditure of husband's earning	Women alone	0.008	0.105	0.078	0.937	1.008	0.821	1.238
	With Husband/partners	0.009	0.100	0.094	0.925	1.009	0.830	1.227
	Others	---	---	---	---	1.000	---	---
Decision on Expenditure of women's earning	Women alone	0.063	0.044	1.426	0.154	1.065	0.977	1.160
	With Husband/partners	0.079	0.039	2.026	0.042 *	1.082	1.003	1.168
	Others	---	---	---	---	1.000	---	---
Permission to having medical help	Big problem	---	---	---	---	1.000	---	---
	Not a big problem	0.119	0.035	3.359	0.0001 ***	1.126	1.051	1.207
Getting money needed for treatment	Big problem	---	---	---	---	1.000	---	---
	Not a big problem	0.042	0.023	1.807	0.070.	1.043	0.996	1.092
Distance to health facility	Big problem	---	---	---	---	1.000	---	---
	Not a big problem	0.035	0.022	1.586	0.113	1.036	0.992	1.081
Owns a mobile telephone	No	---	---	---	---	1.000	---	---
	Yes	0.112	0.022	5.036	0.000***	1.119	1.071	1.169
Media exposure (TV)	Not at all	-0.087	0.037	-2.368	0.0171*	0.917	0.853	0.985
	Less than once a week	-0.184	0.024	-7.506	0.000 ***	0.832	0.793	0.873
	At least once a week	---	---	---	---	1.000	---	---

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4. Discussion

Consistent with previous studies (Bhowmik et al 2019; Bhowmik et al 2020; Islam and Masud 2018; Talukder et al 2021), our results confirmed that ANC contact is significantly influenced by the sex of the household head, residence, wealth index, husband's or partner's education, women's highest educational attainment, how the decision on the expenditure of women's earnings is made, whether it is difficult to obtain permission for medical assistance, mobile phone ownership, and media exposure (TV). In accordance with previous research (Ali et al 2018b; Chanda et al 2020; Rahman et al 2017), our findings also indicate that income inequality, whether a woman has attained at least a primary education, how the decision on husband's income expenditure is made, distance to a health facility, a woman's ability to use a mobile phone for financial transactions, ownership of a mobile phone, and media exposure (television) have a significant impact on the WHO-recommended ANC contact among pregnant women. "ANC contact" and "WHO-recommended ANC contact" are not statistically significant in relation to obtaining treatment funds (getting money needed for treatment).

This research outcome is somewhat unexpected. This highlights the importance of societal perceptions in determining women's access to ANC services. Although "Sex of household head" and "Residence" play a major role in "ANC contact," they do not play a significant role in "WHO-recommended ANC contact" for women. In the patriarchal society of Bangladesh, a

male often makes the majority of financial decisions for the family, especially in situations involving expenditures. Therefore, it is crucial that the head of the household or the husband/partner be aware of these issues.

Table 4 The estimated regression coefficient (β) and odds ratio (OR) of not attending any ANC visit with their 95% CI and p values from the hurdle negative binomial regression in the zero-part model.

		β	Std. Error	z value	Pr(>|z|)	OR	95% CI	
Factors	Intercept	1.792	0.494	3.630	0.0002 ***	5.999	2.280	15.781
Sex of household head	Male	0.143	0.176	0.813	0.416	1.154	0.817	1.631
	Female	---	---	---	---	1.000	---	---
Residence	Urban	0.065	0.139	0.468	0.640	1.067	0.813	1.401
	Rural	---	---	---	---	1.000	---	---
Wealth Index	Poor	-0.391	0.163	-2.395	0.016 *	0.676	0.491	0.931
	Middle	---	---	---	---	1.000	---	---
	Rich	0.605	0.210	2.882	0.003 **	1.831	1.214	2.763
Husband/partner's Education	Educated	---	---	---	---	1.000	---	---
	Uneducated	-0.311	0.132	-2.362	0.018 *	0.733	0.566	0.949
Husband/partner's Occupation	Have work	-10.021	492.442	-0.020	0.984	0.000	0.000	Inf
	Do not Have work	---	---	---	---	1.000	---	---
Women's Highest Educational attainment	No Education	---	---	---	---	1.000	---	---
	Primary and Above	0.741	0.119	6.224	0.000***	2.097	1.661	2.648
Women's Occupation	Not working	---	---	---	---	1.000	---	---
	Working	10.055	492.442	0.020	0.984	23265.341	0.000	Inf
Decision on Expenditure of husband's earning	Women alone	0.091	0.463	0.197	0.844	1.095	0.442	2.715
	With Husband/partners	0.024	0.420	0.058	0.954	1.024	0.450	2.333
	Others	---	---	---	---	1.000	---	---
Decision on Expenditure of women's earning	Women alone	-0.140	0.225	-0.623	0.533	0.869	0.560	1.350
	With Husband/partners	-0.102	0.189	-0.539	0.590	0.903	0.623	1.309
	Others	---	---	---	---	1.000	---	---
Permission to having medical help	Big problem	---	---	---	---	1.000	---	---
	Not a big problem	0.335	0.154	2.182	0.029 *	1.398	1.035	1.889
Getting money needed for treatment	Big problem	---	---	---	---	1.000	---	---
	Not a big problem	0.226	0.124	1.821	0.068.	1.253	0.983	1.598
Distance to health facility	Big problem	---	---	---	---	1.000	---	---
	Not a big problem	0.112	0.116	0.964	0.335	1.119	0.891	1.405
Owns a mobile telephone	No	---	---	---	---	1.000	---	---
	Yes	0.348	0.116	2.993	0.002**	1.416	1.128	1.779
Media exposure (TV)	Not at all	-0.907	0.140	-6.501	0.000 ***	0.404	0.307	0.531
	Less than once a week	-0.333	0.220	-1.517	0.129	0.717	0.466	1.102
	At least once a week	---	---	---	---	1.000	---	---

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Rural adolescent married women are less likely to utilize competent maternal health services than their urban counterparts, which may account for the disparity in ANC treatment utilization between urban and rural settings. The greater odds for urban areas are consistent with the notion that the existence of health care centers has boosted urban women's access to maternal health services relative to rural women. Therefore, it is vital to increase the number of facility-based care centers and improve rural transportation. The wealth index variable of this study reveals a substantial disparity between affluent and poor families receiving ANC contact and WHO-recommended ANC contact services. The higher utilization of antenatal care among women from the wealthiest households demonstrates that cost may be a hurdle to antenatal care utilization. Although maternity services in the public sector in Bangladesh are technically free, concealed costs to families (such as hospital fees and corruption) may discourage less affluent families from receiving treatment (Koenig et al 2007). Priority must be given to disadvantaged and vulnerable women who may not have access to competent prenatal and delivery care when implementing interventions for safe motherhood. We recommend enhancing the demand-side finance (DSF) program that targets the 20% poorest women. Initiated in 2004, the DSF is a maternal health voucher program devised by the Bangladesh Ministry of Health and Family Welfare (MOHFW) with World Health Organization assistance (WHO). It has

been determined that the DSF increases access to maternity care (Bernstein 2005; Magadi et al 2007; Schmidt et al 2010). Access to health care is a constitutionally protected fundamental right for Bangladeshi citizens. The study's findings demonstrate the need for more effective government action to guarantee equal access to health care for all. Therefore, financing in the health sector through insurance or different organizations may reduce these obstacles.

Table 5 Binary logistic regression to determine the factors influencing the WHO-recommended ≥4 ANC contacts.

		β	Std.Error.	Pr(>|z|)	OR	95% CI	
Factors	Categories	21.363	28252.300	0.000			
Sex of household head	Male	0.347	0.229	0.131	1.414	0.902	2.216
	Female	---	---	---	1.000	---	---
Residence	Urban	-0.011	0.183	0.954	0.990	0.691	1.416
	Rural	---	---	---	1.000	---	---
Wealth Index	Poor	-0.662	0.214	0.002*	0.516	0.339	0.784
	Middle	-0.174	0.235	0.460	0.841	0.530	1.332
	Rich	---	---	---	1.000	---	---
Husband/partner's Education	Educated	0.107	0.231	0.642	1.113	0.708	1.750
	Uneducated	---	---	---	1.000	---	---
Husband/partner's Occupation	Have work	-20.242	28252.300	0.999	0.000	0.000	
	Do not Have work	---	---	---	1.000	---	---
Women's Highest Educational Attainment	No Education	-0.521	0.209	0.013*	0.594	0.394	0.895
	Primary and Above	---	---	---	1.000	---	---
Women's Occupation	Not working	0.060	0.058	0.300	1.062	0.948	1.190
	Working	---	---	---	1.000	---	---
Decision on women's health care	Woman Alone	0.074	0.325	0.821	1.077	0.569	2.036
	With husband/partner	0.160	0.220	0.467	1.173	0.763	1.804
	Others	---	---	---	1.000	---	---
Decision on Expenditure of husband's earning	Women alone	-0.712	0.406	0.020*	0.491	0.222	1.088
	With Husband/partners	-0.135	0.220	0.541	0.874	0.568	1.346
	Others	---	---	---	1.000	---	---
Decision on Expenditure of women's earning	Women alone	-0.013	0.179	0.941	0.987	0.695	1.401
	With Husband/partners	---	---	---	1.000	---	---
Permission to having medical help	Big problem	0.169	0.310	0.586	1.184	0.645	2.176
	Not a big problem	---	---	---	1.000	---	---
Getting money needed for treatment	Big problem	-0.035	0.174	0.838	0.965	0.686	1.357
	Not a big problem	---	---	---	1.000	---	---
Distance to health facility	Big problem	-0.497	0.170	0.004***	0.609	0.436	0.850
	Not a big problem	---	---	---	1.000	---	---
Use phone for financial transactions	No	-0.368	0.214	0.046*	0.692	0.455	1.054
	Yes	---	---	---	1.000	---	---
Owns a mobile telephone	No	-0.368	0.214	0.046*	0.692	0.455	1.054
	Yes	---	---	---	1.000	---	---
Media exposure (TV)	Not at all	-0.882	0.182	0.000***	0.414	0.290	0.591
	Less than once a week	-0.455	0.277	0.100	0.635	0.369	1.092
	At least once a week	---	---	---	1.000	---	---

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

This study demonstrates that women with at least a primary education are statistically more likely than uneducated women to receive "ANC contact" and "WHO-recommended ANC contact" services. This may be because educated women are more aware of the benefits of antenatal care. Earlier studies conducted in Bangladesh suggest that maternal education is the strongest predictor of maternity care utilization (Anwar et al 2015). It should be highlighted that while Bangladesh has achieved great success in enrolling female children in basic school, it has not had as much success in preventing these children from dropping out. To accomplish the health-related "SDG" targets, the government of Bangladesh must take more effective measures to prevent female students from dropping out. If mothers determine how to spend their own earnings with their husbands or partners, their chances of receiving "ANC contact" considerably rise, according to the findings of this study. These results emphasize the significance of men's participation in women's access to health rights. Significantly greater rates of "WHO-recommended ANC contact" service uptake were observed among mothers who made decisions regarding their husband's or partner's income in partnership with others as opposed to independently, indicating that women require social and familial support and affection. Although "Distance to health facility" does not play a statistically significant influence in the case of "ANC contact," it does in the case of "WHO-recommended ANC contact." "WHO-recommended ANC contact" is also high among women who use a cell phone, can utilize it for financial activities, and watch TV at least once a week. These findings show that media exposure improves maternal health awareness. Mothers' health-seeking was

influenced by media exposure. TV-watching mothers were better aware of pregnancy problems and the importance of ANC treatment. The Bangladeshi government's television health messages may have improved ANC service usage. Increasing mass-media advertisements about the benefits of ANC visits and ANC's suggested content would increase the number of women receiving effective maternity care. Telecommunications also helps mothers financially and humanitarianly.

5. Conclusion

This study has positive and negative aspects. The DHS's large, validated data set is the study's strength. The findings apply nationally and regionally. Due to the cross-sectional study design, probabilistic findings were only possible. Experimental investigations are needed to test hypotheses and draw causal inferences. Despite the government and nongovernment groups' emphasis on ANC as part of safe motherhood policies and programs, Bangladesh is far from universal ANC coverage. Pregnant Bangladeshi women used ANC steadily from 1994 to 2018. Despite several maternal health advances, 4+ ANC progressed slower, as expected. Our findings show that addressing high-risk women, such as those who are illiterate, live in rural regions, have poor incomes, and lack mobile phone and media access, is necessary to promote antenatal care. Bangladesh aims to achieve SDG 3 by 2030 by ensuring universal use of WHO-recommended ANC. The findings may help health care programmers and legislators design optimal ANC coverage for all.

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Ethical considerations

Not applicable

Conflict of Interest

The authors declare no conflicts of interest.

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