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Dominant predictors of postnatal care utilization among ever-married mothers of reproductive age in Bangladesh

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Abstract

The majority of maternal mortality occurs during the postpartum period worldwide. Therefore, postnatal care (PNC) is crucial for both mother's and newborn's survival. Unfortunately, PNC is underutilized in Bangladesh and well below any admissible level. The purpose of this study is not only to identify the potential factors associated with PNC but also to explore the more intriguing aspect of finding the most important determinants of PNC receipt among mothers in Bangladesh. Binary logistic regression analysis was employed to determine the factors associated with PNC receipt using data from the Bangladesh Demographic and Health Survey (BDHS) 2017–18. The BDHS 2017–18 utilized a two-stage stratified sampling method, selecting 675 enumeration areas (EAs) in the first stage with probability proportional to size and then choosing a systematic sample of 30 households from each EA in the second stage. The analysis considered mothers with a most recent child under three years of age at the time of the survey, leading to a total of 4899 women. The response variable of interest is the receipt of PNC from a medically trained provider (MTP) within two days of delivery. It is observed that 52.8% of mothers received PNC from MTP within two days of childbirth. The variables mother's age at birth, birth order, mother's education level, place of residence, wealth index, media exposure, antenatal care (ANC) visits, working status, and region are all found to be significantly associated with PNC seeking behavior. General dominance (GD) analysis was employed to assess variable importance because complete, and conditional dominances rarely occur. GD is the simplest among the three dominances and can be computed without computing the other two by using a simpler subset model structure. Considering the two-stage stratified sampling design, the analysis reveals that ANC visits, family wealth status, and the mother's education level were the three most dominant predictors of PNC visits, explaining approximately 68% of the total variance. The results suggest that policymakers and stakeholders should intensify the existing facilities to increase awareness of taking ANC visits, which would eventually encourage women to take PNC. Additionally, efforts should be made to help economically disadvantaged women overcome the barriers that prevent them from accessing maternal health care. Finally, the government of Bangladesh should stimulate women to complete at least their secondary education.

Keywords Postnatal care, Postpartum women, Dominance analysis, Bangladesh

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Introduction

The first six weeks after the birth of a baby is the 'postnatal' period [1]. This period is the critical time period for maternal and neonatal survival [2]. PNC includes monitoring danger signs in the newborn's breathing, movement, temperature and breastfeeding as well as counseling the mother on health, nutrition, and healthy lifestyle practices [3–5]. Appropriate and timely postnatal checkups can save lives [2] and have great significance for both mother's and newborn's health because they help mothers overcome complications following birth and provide advice on how to take care of the newborn [6]. As PNC ensures the well-being of mothers and newborns in terms of their health conditions, it contributes to the productivity and stability of families, communities, and the workforce [7].

Despite significant progress in reducing global maternal mortality, the rates are still too high worldwide. In 2020, an estimated 287,000 women lost their lives due to pregnancy complications or underlying conditions worsened by pregnancy or its management during pregnancy and childbirth or within six weeks of termination of pregnancy. Low- and lower-middle-income nations accounted for about 95% of all maternal deaths, the majority of which could have been avoided by monitoring their health conditions and consequently suggesting medication policies accordingly [8]. Sub-Saharan Africa accounted for around 70%, and Southern Asia accounted for almost 16% of global maternal deaths [8, 9]. The estimated global maternal mortality ratio (MMR), the number of maternal deaths per 100,000 live births, was 223 in 2020. The MMR in low-income countries was 430, while it was 13 in high-income countries [8].

Over the decade (from 2010 to 2020), the estimated MMR in Bangladesh has reduced from 301 per 100,000 live births to 123 per 100,000 live births [9]; the day of delivery accounted for 38% of maternal deaths, while the first day following birth accounted for 6% [10]. The target 3.1 of Sustainable Development Goal (SDG) is to reduce global MMR below 70 maternal deaths per 100,000 live births by 2030 [8, 9]. Like MMR, the neonatal mortality rate (NMR) in Bangladesh dropped from 32 deaths per 1,000 live births in 2011 to 28 deaths per 1,000 live births in 2014 before rising once more in 2017–18 (30 deaths per 1,000 live births in 2017-18). The risk of dying in the neonatal period is around four times higher than that of the following 11 months (8 deaths per 1,000 live births in the post-neonatal period) [11].

Between 2004 and 2017-18, the PNC for mothers from medically trained providers (MTP) within 2 days of delivery has been increased from 16 to 52% in Bangladesh [11]. The proportion of women receiving PNC from MTP varies considerably by place of delivery, place of residence, region, mother's education level and age at birth [11]. Despite the increase in prevalence of PNC over the years, this figure remains relatively low when compared to neighboring countries such as Indonesia, Myanmar, India, Nepal and African nations like Zambia [12]. The World Health Organization recommends all mothers and newborns should receive a postnatal check-up within 24 h of birth and at least three additional postnatal check-ups within 42 days of birth [13]. The first 2 days after birth is an ideal time for postnatal check-ups for both mothers and their newborns [11, 14, 15]. Hence, the Government of Bangladesh has set a target to increase PNC coverage from MTP within 48 h of birth to 80% by 2025 and 100% by 2030 [2, 16].

Numerous studies have been conducted to explore the coverage and to find the potential determinants of PNC for mothers in Bangladesh. Using longitudinal data on maternal morbidity in Bangladesh, Chakraborty et al. [17] identified that the mother's age at marriage and husband's occupation had strong impact on healthcare utilization. Anwar et al. [18] found that one or more antenatal care (ANC) visits are associated with utilization of PNC. Analyzing BDHS 2007 data, Rahman et al. [14] showed that mother's age at birth, place of residence, mother's education level, ANC visits, place of delivery, household wealth status, husband's occupation, husband's concern regarding pregnancy complications and mother's permission to go to the health center alone were significant determinants for receiving PNC of young mothers. Amin et al. [19] conducted a study in rural areas in three divisions of Bangladesh and found that household wealth status was a major determinant of PNC for mothers. In a study conducted at Madhupur Upazila in Tangail district of Bangladesh, Shahjahan et al. [20] concluded that PNC for mothers was significantly associated with mother's education level, exposure to TV and family income. Using BDHS 2014 data, Mahbub and Zahura [21] found that place of residence, region, mother's education level, household wealth index, media exposure, birth order and ANC visits were the determinants of PNC for mothers in Bangladesh. Kim et al. [15] analyzed BDHS 2014 data and found that the proportion of women receiving specific interventions within 2 days of birth such as breast examination, vaginal discharge examination, temperature check and counseling on danger signs was mostly low and only 16.95% of the women received all four interventions.

To achieve the proposed target for SDG (reduce global MMR below 70 maternal deaths per 100,000 live births by 2030) and target of Government of Bangladesh (reduce MMR to 100 by 2025 and to 70 by 2030; increase PNC coverage from MTP within 48 h of birth to 80% by 2025 and 100% by 2030) [2, 16], it is crucial to study the current scenario of PNC for mothers from MTP within 48 h of delivery and its determinants. Therefore, one of the objectives of this study is: Do demographic,

socioeconomic, and ANC visits factors influence PNC for mothers from MTP within 2 days of birth in Bangladesh? The literature mentioned above focused on the utilization and determinants of PNC for mothers. However, when conducting a regression analysis, researchers and consultants frequently face the question of relative importance of the regressors. Hence, another objective of this study is to investigate the most important determinants of postnatal checkups from MTP within 2 days of delivery. This study will help policymakers and stakeholders to identify the most important determinants of PNC utilization and hence can allocate resources to areas that will have the greatest impact on improving PNC.

Conceptual framework

The conceptual framework in Fig. 1 outlines the expected relationship between PNC for mothers from MTP within 48 h of delivery and demographic, socioeconomic, and ANC visits factors. The variables considered in this framework were obtained from empirical findings in comparable studies [5]. The framework suggested that there may be direct associations between socioeconomic factors and PNC for mothers. Higher educated mothers, for example, may be more conscious of the relevance of PNC. Additionally, direct associations between demographic factors and mothers' receipt of PNC may exist. For instance, older mothers may have a higher likelihood of receiving PNC. Socioeconomic as well as demographic factors may influence ANC visits and mothers who attended more ANC visits may be more likely to utilise PNC services.

Materials and methods

Bangladesh is a densely populated country in South Asia, with an estimated population of over 170 million [22]. The country has approximately an equal percentage of male and female population (50.5% female versus 49.5% male), with nearly half of the female population (46.9%) in reproductive age (15–49 years) [23]. From being one of the poorest nations at birth in 1971, Bangladesh obtained lower-middle income status in 2015 [22]. There have been improvements in maternal health metrics, such as a

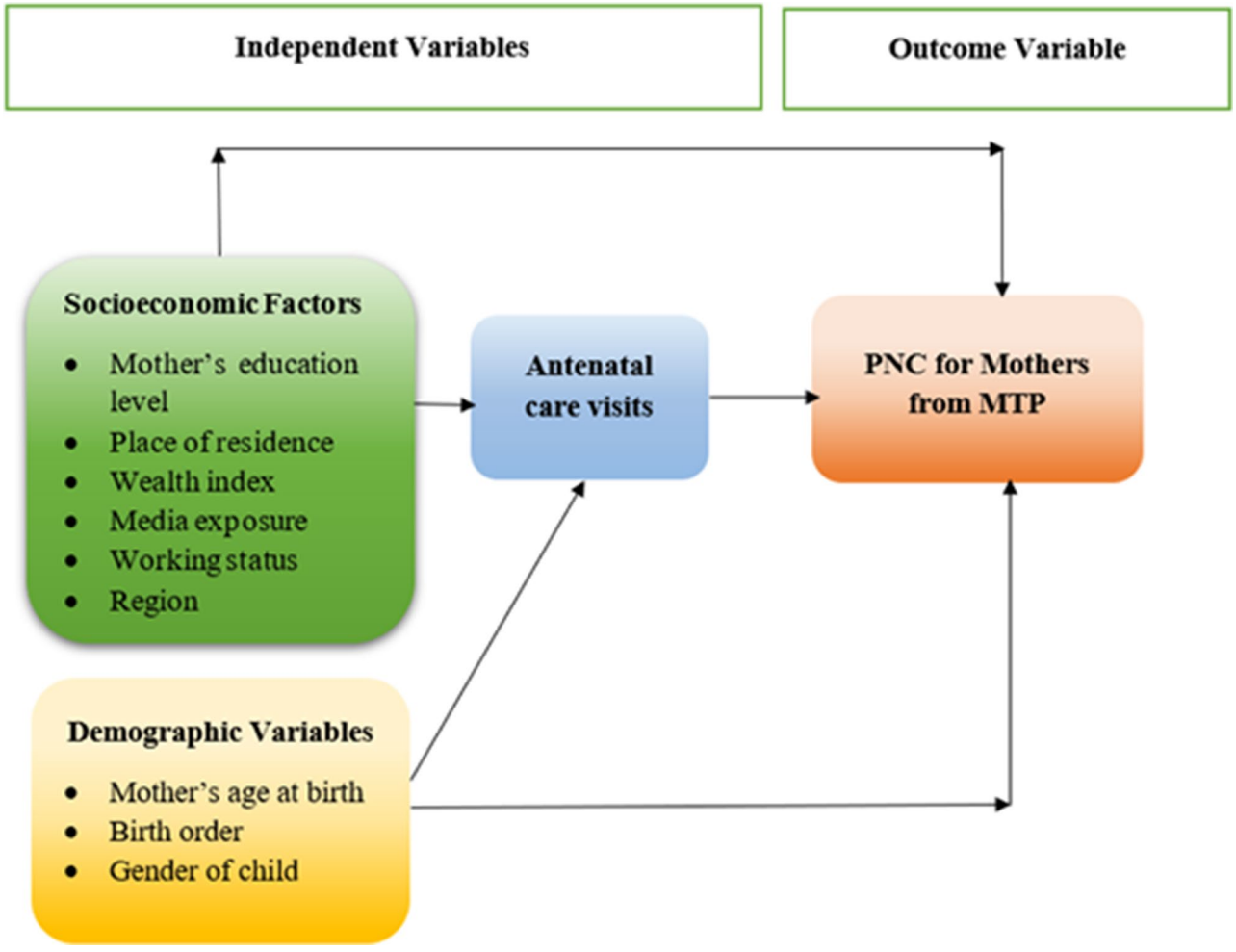

Fig. 1 Conceptual framework

significant reduction in MMR over the past twenty years, but challenges persist in ensuring equal access to PNC.

Data and variables

The data for this study was extracted from the 2017–18 BDHS, which is a nationally representative cross-sectional survey. The BDHS 2017–18 employed a two-stage stratified sampling method. Bangladesh was divided into eight administrative divisions. Each division was stratified into three different areas: urban city corporations, urban areas other than city corporations, and rural areas, which gives a total of 22 sampling strata (2 divisions exclude city corporation areas). In the first stage, 675 enumeration areas (EAs) were selected independently with a probability proportional to EA size, with 227 EAs in urban areas and 448 EAs in rural areas. An EA can be a village, a part of a large village, or a group of small villages with an average of approximately 120 households. A complete list of households from the selected EAs was used as a sampling frame for the selection of households in the second stage. A systematic sample of 30 households per cluster (EA) was selected in the second stage using the sampling frame. Among the selected 20,250 households, 20,127 ever-married women aged 15 to 49 years were successfully interviewed about their pregnancies. For this study, we considered mothers whose most recent child was under three years old at the time of the survey. The number of women was reduced to 4899 after filtering the dataset using the above-mentioned criteria and deleting the missing values corresponding to the explanatory variables considered in this study. This figure includes both institutional deliveries (2461 women) as well as deliveries at home (2438 women).

The response variable of interest is the PNC status received by the mothers from medically trained provider (MTP) within two days of delivery. From now onwards PNC for mothers from MTP will indicate PNC received by mothers from MTP within two days of birth. Medically trained providers include qualified doctors, nurses, midwives, paramedics, family welfare visitors, community skilled birth attendants, and sub-assistant community medical officers [11]. The covariates considered in this study are: mother's age at birth ($\leq$ 18, 19–24, 25–34, $\geq$ 35 years), birth order (1, 2–3, 4–5, $\geq$ 6 births), mother's education level (no, primary, secondary, higher education), gender of child (male, female), place of residence (urban, rural), wealth index (poor, middle, rich), media exposure (low, medium, high), antenatal care visits (0, 1–3, 4–7, $\geq$ 8), mother's working status (no, yes), and region (Central, Eastern, Western).

Some covariates were not readily available in the BDHS 2017–18 dataset. The wealth index was categorized (based on the cut-points of the wealth score) as poor ($\leq$ 33.33%), middle (33.34–66.66%), and rich ($\geq$ 66.67 %). The frequencies of reading newspapers or magazines, or watching television, or listening radio (0 = not at all, 1 = less than once a week, 2 = at least once a week) were combined using principal component analysis to form scores ranging between 0 and 9 [24]. The principal component scores were categorized as low, medium, and high. According to WHO [25], a minimum of four ANC visits are considered sufficient for safe pregnancy and childbirth for healthy women with no underlying medical problems. Recently, WHO [26] recommended to attend at least eight ANC visits. Hence the number of ANC visits was categorized as no (0), 1–3, 4–7, and $\geq$ 8 . Eight administrative divisions was grouped into three regions to reduce geographical heterogeneity. Like some studies in Zambia and Lao PDR [5, 27], we have considered region as a covariate of PNC. The regions are Eastern (Sylhet, Chattogram), Central (Dhaka, Mymensingh, Barishal), and Western (Rajshahi, Rangpur, Khulna), a classification that has been used in previous studies in Bangladesh [28]. The regions were identified based on the map of Bangladesh.

Statistical analysis

We performed univariate analysis (frequency distribution) to observe the fundamental characteristics of the explanatory variables within the sample, and bivariate analysis (chi-square test) to investigate the relationship between the response variable and the selected explanatory variables. The chi-square statistic compares the observed cell counts with their respective expected cell counts, aiming to ascertain the independence or dependence between the response variable and the selected categorical variables. The bivariate analysis served as a foundation for selecting explanatory variables to be included in the multivariate analysis. A binary logistic regression was used to identify the determinants of PNC for mothers from MTP. Finally, dominance analysis, particularly general dominance, was applied to evaluate the relative importance of the determinants of PNC for mothers received from MTP. The statistical software STATA 14 was employed to perform univariate, bivariate, and multivariate analyses. To address the stratified two-stage sampling design, we used the **svyset** command of STATA in the bivariate and multivariate analyses. For dominance analysis, we considered the survey setting, **svyglm()** function, in the **R** programming language. The dominance analysis using a simple random sample is available in **R**. The **R** code for calculating general dominance while taking the survey setting into account is available upon request from the corresponding author.

Logistic regression model

Let $y_i (i = 1, 2, \ldots, n)$ be the binary response for the i th individual. The value $y_i = 1$ indicates that ith woman

received PNC from MTP and $y_i = 0$ otherwise. Also, let $P(y_i = 1) = \pi_i$ is the probability of receiving PNC from MTP for the ith woman. Then the link function of binary logistic regression model is [29]

$$g(\pi_i) = \text{logit}(\pi_i) = \log\left(\frac{\pi_i}{1-\pi_i}\right) = \boldsymbol{x}_i^{\top}\boldsymbol{\beta}$$

where $\boldsymbol{x}_i = (1, x_{i1}, x_{i2}, \ldots, x_{ik})^{\top}$ is a $p \times 1$ vector of covariates for the ith individual and $\boldsymbol{\beta} = (\beta_0, \beta_1, \beta_2, \ldots, \beta_k)^{\top}$ is a $p \times 1$ vector of regression parameters with $p = k + 1$.

Relative importance of predictors

Similar to multiple linear regression, researchers may be interested in identifying the most important predictors among the several predictors in a logistic regression model. Recently, the dominance analysis technique has been extensively used by researchers to examine the predictor importance more accurately in multiple linear regression analysis [30, 31]. Dominance analysis was originally proposed by Budescu [32] and refined and extended by Azen and Budescu [33] to identify the relative importance of variables in a multiple regression analysis. Recently, Azen and Traxel [34] extended the dominance analysis procedure of multiple regression to evaluate the predictor's importance in logistic regression. Also, Tonidandel and LeBreton [31] proposed the Johnson's [35] relative weight analogue for logistic regression. In multiple linear regression with p predictors, dominance analysis evaluates the change in R^2 to a given subset model due to the addition of a new variable in the model. If the additional contribution of a variable is greater than that of the other predictors for every possible subset model, the variable is said to have *complete dominance* in the analysis. A predictor is said to have *conditional dominance* over the other variables if its average additional contribution is greater than the other predictors within each model size. Whereas *general dominance* refers to the situation in which the average conditional contribution of a variable is greater than that of the other predictors over all possible models. Complete dominance and conditional dominance can rarely happen [33]. Hence, in this research we particularly used the general dominance analysis approach, which is the simplest of the three dominances, to determine the variable importance in logistic regression. One appealing property of general dominance is that the sum of general dominance weights is always equal to model R^2 [36]. The relative importance values proposed by Lindeman et al. [37] (called LMG) are equal to the general dominance values [30, 33, 38]. However, LMG has a simpler arrangement of subset models than general dominance. Hence, we applied the subset models' arrangement of LMG to evaluate general dominance. Dominance analysis in logistic regression requires an R^2 analogue for logistic regression. According to Azen and Traxel [34], three popular R^2 analogues based on likelihood ratios were proposed by McFadden [39], Nagelkerke [40] and Estrella [41]. These measures satisfied at least three of the four criteria of R^2 analogues namely boundness, linear invariance, monotonicity, and intuitive interpretability [34]. Among them, McFadden and Estrella R^2 satisfies all four criteria while Nagelkerke measure holds only three of four criteria. Azen and Traxel [34] proved algebraically that all three measures produce identical directions of dominance. They illustrated the general dominance analysis in a logistics regression analysis using a dataset that studied teenagers' attitudes and behavior concerning tobacco. In our study, we applied only McFadden's R^2, which is the simplest to compute than the others, to evaluate the variable importance (general dominance) of the determinants of PNC for mothers received from MTP.

Suppose L_0 represents the likelihood of the intercept-only model and L_M is the fitted model. Then, according to McFadden [39], the analogous measure of R^2 is

$$R^2_M = 1 - \frac{\ln(L_M)}{\ln(L_0)}$$

R^2_M varies naturally between 0 and 1 and is independent of the units of measurement of the covariates used in the model. This measure is also monotonic increasing, i.e., it does not decrease with the addition of a covariate and has an intuitively reasonable interpretation [34].

Results

In order to analyze the PNC receiving status from MTP, a total of 4899 (unweighted number) mothers have been taken into consideration after accounting for missing variables. The frequency and percentage distribution of each category of covariates, together with the conditional weighted percentage distribution of each category of covariates who received PNC from MTP within two days of delivery, are displayed in Table 1. It was observed that 52.8% of mothers received PNC from MTP within two days of childbirth. In the case of institutional delivery PNC from MTP was 97.9% whereas it was only 7.3% for delivery at home. It was also observed that no women received PNC after discharge from the institution. More than two-fifths of the mothers (41.1%) were aged between 19 and 24 years at the time of index birth, and more than one-third (34.9%) were aged between 25 and 34 years. About half of the mothers (49.8%) reported that the index child was their second or third child, and a majority of mothers (48.0%) had secondary education. The index children were roughly equally distributed between

Table 1 Percentage distribution of PNC receiving status for mothers and 95% confidence interval (CI) by some selected socioeconomic and demographic characteristics, BDHS 2017–18

Variable	*n*(%)	PNC for mothers		*p*-value
		% PNC by MTP	95% CI	
PNC by MTP	2586 (52.8)		(49.73–54.39)	
*Mother's age at birth***				0.032
≤ 18	987 (20.2)	52.18	(48.29–56.06)	
19–24	2014 (41.1)	54.34	(51.52–57.13)	
25–34	1711 (34.9)	50.02	(46.91–53.14)	
≥ 35	187 (3.8)	45.53	(37.73–53.57)	
*Birth order****				< 0.001
1	1876 (38.3)	63.41	(60.30–66.41)	
2–3	2439 (49.8)	48.85	(46.14–51.56)	
4–5	480 (9.8)	31.72	(26.68–37.23)	
≥ 6	104 (2.1)	17.32	(10.39–27.45)	
*Mother's education level****				< 0.001
No Education	304 (6.2)	28.66	(23.20–34.81)	
Primary	1350 (27.6)	32.91	(29.42–36.60)	
Secondary	2350 (48.0)	56.02	(53.40–58.60)	
Higher	895 (18.2)	79.85	(76.49–82.83)	
Gender of child				0.436
Male	2568 (52.4)	52.63	(49.90–55.35)	
Female	2331 (47.6)	51.45	(48.63–54.25)	
*Place of residence****				< 0.001
Urban	1689 (34.5)	65.93	(62.27–69.41)	
Rural	3210 (65.5)	46.99	(44.17–49.82)	
*Wealth index****				< 0.001
Poor	1795 (36.6)	32.42	(29.36–35.65)	
Middle	1583 (32.3)	52.58	(49.44–55.70)	
Rich	1521 (31.1)	75.03	(72.17–77.69)	
*Media exposure****				< 0.001
Low	1749 (35.7)	35.33	(31.89–38.92)	
Medium	2590 (52.9)	57.27	(54.74–59.77)	
High	560 (11.4)	79.13	(74.36–83.21)	
*Antenatal care visits****				< 0.001
No	399 (8.1)	14.89	(10.75–20.25)	
1–3	2131 (43.5)	42.73	(39.94–45.58)	
4–7	1795 (36.6)	64.58	(61.67–67.38)	
≥ 8	574 (11.7)	75.86	(71.40–79.82)	
*Working status****				< 0.001
No	3066 (62.6)	57.05	(54.22–59.83)	
Yes	1833 (37.4)	43.69	(40.73–46.70)	
*Region***				0.032
Central	1836 (37.5)	53.14	(49.40–56.84)	
Eastern	1489 (30.4)	47.29	(42.52–52.10)	
Western	1574 (32.1)	55.09	(51.43–58.69)	

***p-value < 0.01, **p-value < 0.05, *p-value < 0.1

genders (52.4% male vs. 47.6% female). Around two-thirds of the mothers (65.5%) lived in rural areas, and 36.6% of mothers were from poor households. More than half of the mothers (52.9%) had a medium level of media access while only 11.4% had a high level of media access. Nearly half of the mothers (48.3%) had at least four ANC visits for their most recent pregnancy. More than half (62.6%) of the mothers of newborns were unemployed at the time of the survey. Of the mothers, 37.5% were from the central region of Bangladesh, while 30.4% and 32.1% were from the eastern and western regions, respectively.

It was observed that all the covariates, except for the child's gender, had a significant association with PNC for mothers from MTP. Mothers who were children or youth had a higher percentage of PNC coverage than their adult counterparts. It was found that the percentage of mothers receiving PNC was highest among those who had recently given birth to their first child (63.4%), and this figure declined with increasing birth order.

As expected, mothers with higher education had the highest PNC coverage (79.9%), followed by those with secondary and primary education, while mothers without formal education had the lowest PNC coverage (28.7%). It was found that mothers in urban regions received PNC at a rate that was significantly greater than women in rural areas (65.9% vs. 47.0%). It was observed that mothers from rich families had the highest (75.0%) rate of PNC from MTP within two days of delivery, followed by those from families with middle-wealth (52.6%) and poor families (32.4%). PNC coverage form MTP was highest among those with high media exposure (79.1%), followed by those with medium exposure (57.3%), and lowest among those with low exposure (35.3%). As expected, mothers who had eight or more ANC visits had the highest percentage of PNC from MTP (75.9%), which dropped with reduced ANC visits. Surprisingly, PNC by MTP was significantly higher among non-working mothers (57.1%) than working mothers (43.7%). It was observed that the PNC receiving rate varied across regions. Mothers from the western region of Bangladesh had the highest proportion of PNC from MTP (55.1%), followed by those from the central (53.1%) and eastern (47.3%) regions.

To determine the adjusted effects of the selected covariates on PNC for mothers from MTP, covariates that were significantly associated with PNC in the bivariate analysis were included in the logistic regression analysis. Before conducting regression analysis, we computed variance inflation factors (VIFs) to assess multicollinearity. All VIFs were found to be below 2, indicating no significant correlation among the covariates [42]. Figure 2 presents the estimated odds ratios from the fitted logistic regression model, along with the 95% confidence intervals, displayed in a forest plot. All covariates included in the logistic regression model had a significant effect on PNC

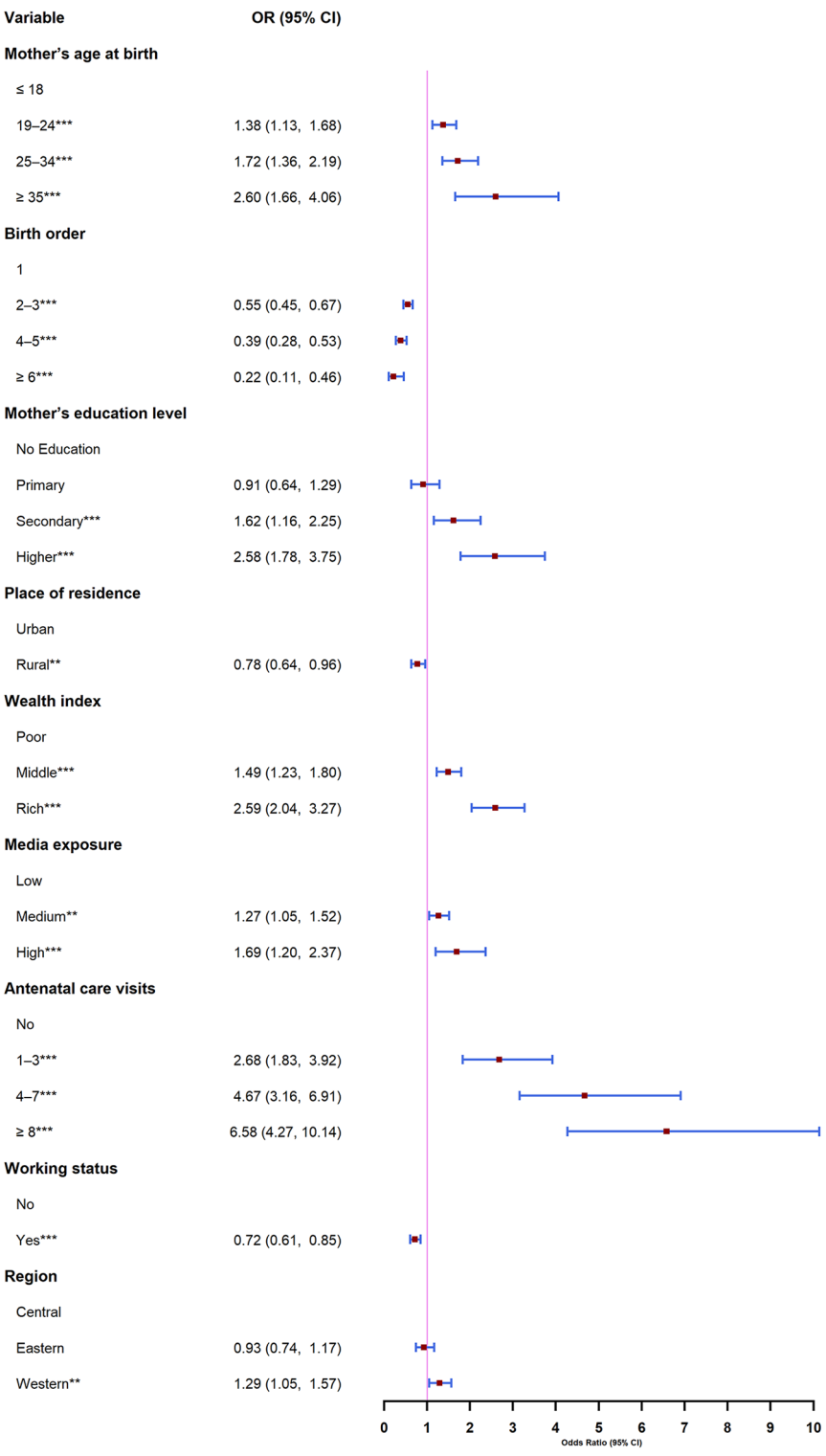

Fig. 2 Estimates of odds ratio with 95% confidence interval (CI) from logistic regression model for the determinants of PNC for mothers by MTP (***p-value < 0.01, **p-value < 0.05, *p-value < 0.1)

for mothers from MTP within two days of delivery. The adjusted effect of mother's age at birth in the regression model indicates that maternal age has a positive influence on the likelihood of receiving PNC. Adult mothers (aged $\geq$ 35 years) were 2.60 times likely to receive PNC from MTP compared to mothers aged $\leq$ 18 years. The likelihood of receiving PNC for mothers from MTP decreased significantly with an increase in birth order. Mothers who

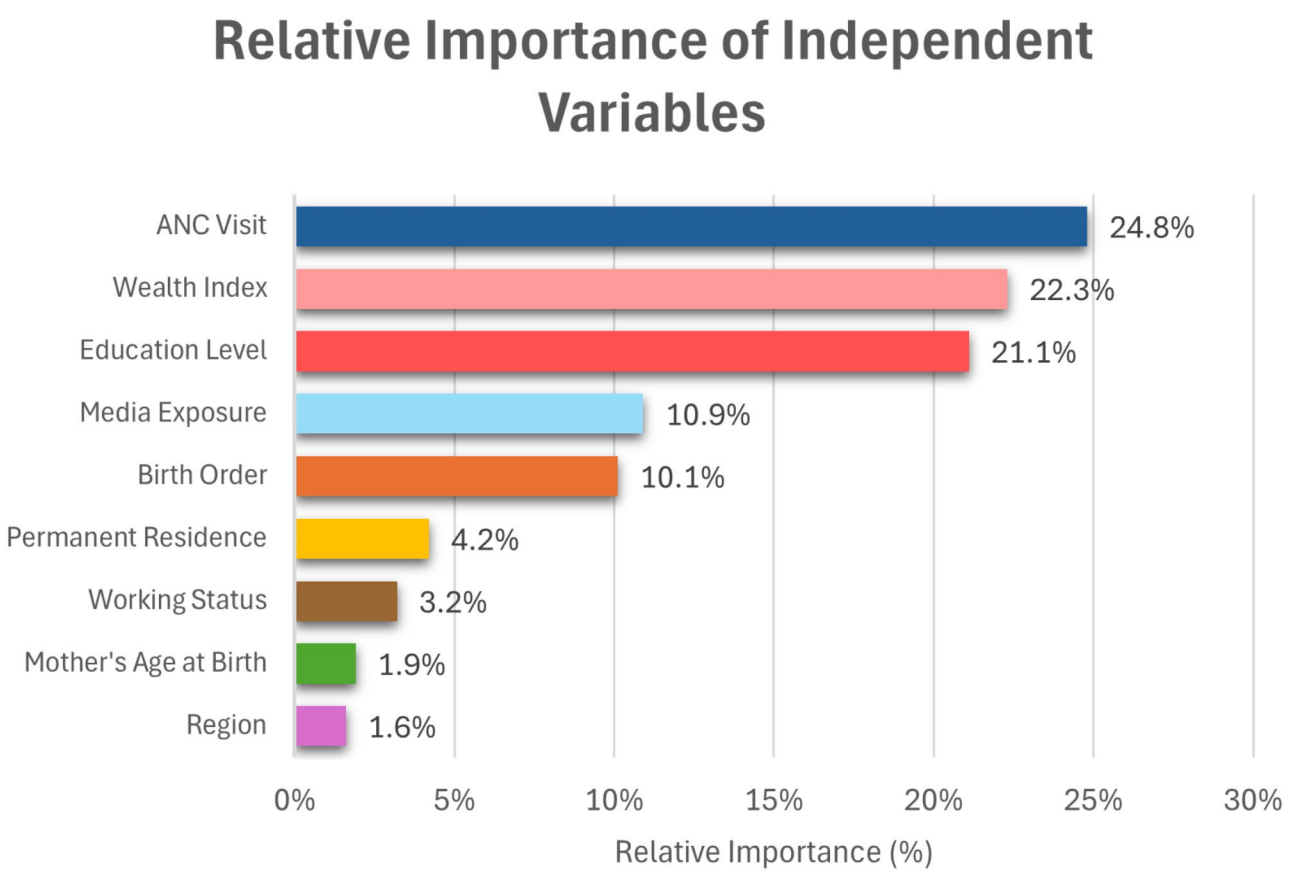

Fig. 3 Relative importance of the factors of PNC for mothers from MTP

reported that the index child as their sixth or later birth had 78% lower odds of receiving PNC from MTP compared to mothers who had their first child. The odds of obtaining PNC from MTP were reduced by 61% and 45% for mothers who stated that the index child is their fourth or fifth birth and second or third birth, respectively compared to first-order birth. The likelihood of receiving PNC from MTP increased significantly with the increase in education level. Mothers with higher and secondary education were 2.58 times and 1.62 times likely, respectively, to receive PNC from MTP compared to mothers with no formal education.

Mothers living in rural areas had 22% lower odds of receiving PNC form MTP compared to mothers in urban areas. The likelihood of receiving PNC from MTP increased significantly with the increase in household wealth. Mothers from rich and middle household wealth status were 2.59 times and 1.49 times likely, respectively, to receive PNC from MTP compared to mothers from poor households' wealth. Compared to mothers with low media exposure, those with medium and high levels of media exposure had 27% and 69% higher odds, respectively, of receiving PNC from MTP. The odds of mothers receiving PNC from MTP increased significantly with the increase in the number of ANC visits during the pregnancy period. Mothers who attended WHO recommended eight or more ANC visits for their index pregnancy were 6.58 times likely to receive PNC from MTP within two days of delivery compared with those who did not attend any ANC visit. The odds ratios for mothers with 1–3 and 4–7 ANC visits were 2.68 and 4.67, respectively. Working mothers had 28% lower odds of receiving PNC from MTP compared to those who were not working at the time of the survey. Mothers from the western region had 29% higher odds of attending PNC from MTP than mothers from the central region.

The log-likelihoods of full and null models are − 2773.90 and − 3391.54, respectively. Hence the McFadden R^2 is 0.182. The predictors of PNC for mothers from MTP in Bangladesh have been ranked employing general dominance analysis. Since all covariates were found significant in the logistic regression analysis, we considered all of them in the general dominance analysis. General dominance analysis revealed that the number of ANC visits was the most important predictor of PNC status for mothers from MTP, followed by household wealth status, the mother's level of education, and so forth (Fig. 3).

Discussion

The present study provides evidence that the likelihood of PNC utilizing behavior of mothers from MTP within two days of delivery increased with the number of ANC visits. ANC attendance has been positively associated with PNC attendance in several earlier studies in India [43], Pakistan [44], Nepal [45], and Uganda [46]. Previous studies in Bangladesh have yielded a similar result [12, 14, 18, 21]. One plausible explanation of this finding is that through comprehensive counseling during ANC visits, mothers may become more informed about potential postpartum complications and the available sources of quality healthcare services for their treatment [12, 17]. However, Chakraborty et al. found no significant impact of ANC visits on PNC in Bangladesh [17]. The difference in findings could be due to several factors. The Chakraborty et al. study used data from an earlier period (November 1992 to December 1993). Whereas the BDHS 2017-18 dataset reflects more recent trends, potentially showing improved healthcare access and increased awareness of maternal health over time. Healthcare system improvements, government initiatives, and better health infrastructure likely contributed to a stronger link between ANC and postnatal care. Additionally, differences in study methodologies, such as statistical models, data quality, and sample characteristics, might account for the discrepancy.

The study found that mothers with a middle or rich household wealth status were more likely to receive PNC from MTP within two days of delivery than mothers with a poor household wealth status. This is consistent with findings from Pakistan [44], Nepal [45], Eswatini [47] and Bangladesh [12, 21]. The higher utilization of PNC services among women from wealthier families can be attributed to their greater access to health information from skilled healthcare professionals, the ability to afford transportation to health facilities, and the financial capacity to cover the costs of PNC services.

Our findings demonstrated that mothers with secondary or higher education were more likely to receive PNC from MTP within two days of childbirth. This aligns with studies in Nepal [45], Myanmar [48], Pakistan [44] as well as three earlier studies in Bangladesh [12, 20, 21]. Women with higher education demonstrate greater health awareness, more proactive health-seeking behavior, and stronger decision-making abilities regarding healthcare compared to those with less education [49]. However, Chakraborty et al. [17] and Amin et al. [19] found no significant association between maternal education and the utilization of postpartum healthcare in Bangladesh. The difference may be due to improved education access, changing socio-economic conditions, and increased awareness over time. The BDHS 2017-18 data reflects these shifts, showing a stronger link between education and postnatal care.

It has been established that age has a significant impact on women's use of healthcare services [17]. The present study provides evidence that the likelihood of PNC utilization form MTP increased with mother's age at birth. This is similar to what was reported in Lao PDR and Malawi [27, 50]. Rahman et al. [14] also found a significant positive association between young mothers' utilization of postpartum care and mother's age at delivery in Bangladesh. A longitudinal study on maternal morbidity confirmed a significant and positive impact of mother's age at marriage on quality PNC services in Bangladesh [17]. A mother's age at childbirth may act as a proxy for her educational background and social status, which could positively affect her use of maternal health services [14, 17].

This study outlined that mothers with neonates of birth order second or more were less likely to seek PNC from MTP within 48 h of delivery compared to mothers with first birth order. A study in rural Myanmar reported that first birth order was pull factor of full PNC utilization [48]. Using BDHS 2014 data, Mahbub and Zahura [21] also found that the likelihood of PNC for mothers decreased with the increase of birth order. Having more children can lead to resource constraints, which negatively impact healthcare utilization [14, 17]. However, Sheba et al. [12] did not find any significant association between PNC utilization for mothers and birth order utilizing BDHS 2017–18 data. This discrepancy may be due to the selection of the reference category. In our study, we considered first birth order as the reference category, whereas Sheba et al. [12] used six or higher birth order.

Consistent with studies from Pakistan [44], Nepal [45], Ethiopia [51] and Bangladesh [12, 21], this study revealed that mothers residing in urban areas were more likely to engage in PNC service utilization compared to those living in rural areas. This could be due to urban women having access to information on PNC from multiple sources, or because urban areas have a higher number of healthcare facilities [51]. Moreover, lack of transportation, long distances to health centers, and bad roads might restrict rural women from accessing PNC services [49].

Our study confirmed that there was a significant and positive impact of media exposure on PNC for mothers from MTP. This finding is justified by earlier studies in sub-Saharan Africa [52], rural Malawi [53] and Bangladesh [20, 21, 54]. Fatema and Lariscy [55] analyzed Demographic and Health Surveys data conducted between 2014 and 2017 from four South Asian Countries and concluded that mass media exposure had a positive association with PNC for mothers. Mothers with access to mass media are more aware of PNC services, which increases their chances of receiving PNC [52].

Additionally, the media has the potential to encourage lower-educated mothers to utilize PNC services [55].

Surprisingly, this study revealed that working women had lower odds of PNC from MTP than those who were not working at the time of the survey. A similar finding was observed in Sierra Leone [56] and Nepal [45]. In Bangladesh, many women are employed in informal sectors or low-wage jobs, where flexible work arrangements and paid leave are either unavailable or very limited. As a result, they often face difficulties attending postnatal checkups, particularly when these appointments fall during working hours. However, contrary findings were observed in Nigeria [57], Malawi [50] and rural Ethiopia [58].

The study found that the likelihood of PNC utilization varies across geographical regions that agree with studies in Lao PDR [27], Indonesia [59], Malawi [50] and a study in Bangladesh [12]. However, no significant regional variation was observed in PNC utilization in Zambia [5]. The regional differences in postnatal care services can be largely attributed to variations in the quality of maternal healthcare programs, as well as differences in the availability and accessibility of services across regions [54].

The current study has several strengths. To the best of our knowledge, it is the first study in Bangladesh to identify the dominant predictors of PNC for mothers from MTP within two days of delivery. We used data from a nationally represented survey and hence, the findings are generalizable for the entire country. The estimates of the current study have been generated utilizing BDHS sampling design and hence are likely to yield more valid estimates [60]. However, this study has several limitations. The pregnancy complications variable has not been included in our study because the BDHS 2017–18 dataset has no information regarding pregnancy complications. It is expected that if a mother had complications during pregnancy or her newborn was sick then they had a higher likelihood of receiving PNC. The information regarding PNC and its factors that were included in this study was collected retrospectively and that may yield some recall bias. To minimize this bias, we considered a 3-year recall period. Additionally, information specific to outpatient PNC, as well as detailed data on those who die in the postpartum period, was not available in the BDHS 2017–18 data.

Conclusion

Based on the nationally representative BDHS 2017–18 dataset, this study examines the dominant predictors of PNC for mothers from MTP within two days of delivery. Around 53% of mothers received PNC from MTP within two days of childbirth. All the covariates considered in the multivariate analysis had a significant influence on PNC for mothers. The general dominance analysis provides evidence that ANC visits, wealth index, and education level of mothers were the three most dominant predictors of PNC for mothers from MTP within two days of delivery.

The use of PNC would be effectively stimulated by programs to increase ANC usage. Also, initiatives should be taken to make PNC services easily accessible to all women irrespective of socio-economic status. In addition, it is crucial that steps should be taken to educate women. Therefore, to boost the PNC component of the maternal health care system, targeted policy measures are required, such as health promotion, and improved education campaigns.

Further analysis can be conducted to evaluate the important predictors of PNC for mothers from MTP using the remaining two dominance analysis methods. Studies can be conducted on the timing of the first PNC in Bangladesh.

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Author contributions
Conceptualization: ZRS, GR, FA, EH. Data curation: ZRS, GR, FA, EH. Formal analysis: ZRS, EH. Administration: ZRS, FA. Supervision: ZRS, EH. Writing–original draft: ZRS. Writing– review & editing: ZRS, GR, FA, EH.

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Data availability
The secondary data from Demographic and Health Surveys (DHS) Program used in this study is available online at: https://dhsprogram.com/data/available-datasets.cfm.

Declarations

Ethics approval and consent to participate
No ethics approval was required as this study used anonymized data from BDHS 2017-18. A signed written consent about the survey was read and given to every respondent before the interview. We have obtained permission from MEASURE DHS to access and analyze BDHS 2017-18 dataset.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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