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Maternal postnatal care in Bangladesh: a closer look at specific content and coverage by different types of providers

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Background The first 48 hours after birth is a critical window of time for the survival for both mothers and their newborns. Timely and adequate postnatal care (PNC) is being promoted as a strategy to reduce both maternal and newborn mortality. Whether or not a woman has received a postnatal check within 48 hours has been well studied, however, specific content and type of provider are also important for understanding the quality of the check. The objective of this paper is to understand who receives specific PNC interventions by type of provider in Bangladesh.

Methods Data from the 2014 Bangladesh Demographic and Health Survey (DHS) were used to study receipt of specific PNC interventions – breast exam, vaginal discharge exam, temperature check and counseling on danger signs – within 2 days of birth. Descriptive bivariate analyses and regression analyses using generalized estimating equations (GEE) were used to understand if receipt of an intervention differed by socio-economic and health-related factors. A key factor studied was the type of provider of the PNC.

Results The proportion of women receiving specific interventions during maternal PNC was mostly low (41.81% for breast exam, 39.72% for vaginal discharge, 82.22% for temperature check, 55.56% for counseling on danger signs and 16.95% for all four interventions). Findings from the regression analyses indicated that compared to having postnatal contact with formal providers (doctors, nurses, midwives and paramedics), having postnatal contact with village doctors was significantly associated with lower probabilities of receiving a breast exam, vaginal discharge exam and receiving all four interventions. PNC provided by NGO workers and other community attendants was significantly associated with a lower probability of receiving a vaginal discharge exam but a higher probability of receiving counseling on danger signs.

Conclusions During PNC, women were much more likely to receive a temperature check than counseling on danger signs, breast exams or vaginal discharge exams. Very few women received all four interventions. In the situation where Bangladesh is experiencing a shortage of high-level providers, training more types of providers, particularly informal village doctors, may be an important strategy for improving the quality of PNC.

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The maternal mortality ratio (MMR) in Bangladesh was 196 deaths per 100,000 live births in 2016, which is largely similar to the MMR in 2010 (*1*). Considering that the first target of Sustainable Development Goal (SDG) 3 is to reduce the global MMR to less than 70 deaths per 100,000 live births by 2030 (*2*), continued attention is required in this area. The risk of mortality for mother and newborn can be high in the first days after birth (*3*). Timely and adequate postnatal care (PNC) during this critical time period can potentially make a significant difference in their survival (*4*). Specifically, the first two days are frequently identified as the ideal time for postnatal checks (*5*) although the World Health Organization (WHO) recommends that all women regardless of where they deliver receive PNC in the first 24 hours (*6*).

A number of prior studies have indicated that coverage of women's PNC visits is low in Bangladesh (*7*–*11*). Potential determinants of maternal PNC in Bangladesh have been explored in a few studies as well (*8*, *9*, *12*, *13*). Determinants that have been consistently cited as important in predicting utilization of PNC include exposure to media (TV) (*8*), age of the mother (*9*), residence (*9*), education (*8*, *9*), prior antenatal care visits (*9*), place of delivery (*9*), household income (*8*) or wealth (*9*, *12*), husband's occupation (*9*), concerns about maternal complications by the husband (*9*) and mother's permission to go to a health center (*9*). One study examined healthcare-seeking behaviors of mothers in the event of severe postnatal morbidities such as hemorrhage, convulsions, foul discharge and fever lasting for longer than 3 days and found that even with serious complications, a low proportion of mothers sought professional care (*13*). This was reported in another study specifically conducted in Sylhet district as well (*14*). In a multivariate analysis, mother's age at marriage was positively associated with seeking care from doctors, nurses and family welfare visitors. Having husbands engaged in business and service work were positively associated with seeking care from traditional birth attendants (*13*). Qualitative studies have reported that traditional practices of seclusion from external contact and restricted diet were not conducive to seeking professional PNC soon after birth (*15*, *16*).

Most household surveys only ask if women received a PNC check and not about the content of that check. The 2014 Bangladesh Demographic and Health Survey (BDHS) is among the first to ask whether or not specific interventions were performed during a PNC check. The BDHS includes questions on breast exam, vaginal discharge exam, temperature check and counseling on danger signs, which are considered important practices for PNC. Women are recommended to seek immediate care at a hospital or a health center if their breasts or nipples turn red or become swollen or if there is abnormal vaginal discharge, vaginal bleeding, fever, infection, difficulty urinating, quickness of breath, headaches, chest pain and/or depression, which are all postnatal danger signs to maternal health (*17*). Receipt of above examinations may depend largely on the knowledge and skills of the health providers performing PNC, even though mothers' sociodemographic and prior healthcare use patterns might still be important predictors. For example, women with higher education and more knowledge about complications may seek out care more often or be able to ask for specific types of care during visits.

There are a wide variety of formal- and informal-sector health providers in Bangladesh with a disproportionately high concentration of informal-sector providers in rural areas (*18*). A study surveying a sample of both formal- and informal-sector healthcare providers currently active in Bangladesh found that the average number of doctors and nurses per population of 10,000 sizably varied among administrative divisions, with urban areas having higher numbers than rural areas (*18*). Rural areas had disproportionately high concentrations of unqualified village doctors, community health workers and traditional birth attendants (*18*). Due to the shortage of qualified health providers, a large portion of the population receives care from less-qualified or unqualified health providers (*19*). Thus, it is important to understand the content of PNC provided by different cadres of health workers.

Using data from the 2014 BDHS, there are two objectives of this study. The first objective is to understand the provision of specific PNC interventions overall, and the second objective is to assess provision of PNC interventions by different types of providers in Bangladesh.

METHODS

Dataset

The 2014 BDHS survey provides information about demographics, contraceptive practice, maternal and child healthcare utilization behaviors, diseases prevalent for children under 5, nutritional indicators, infant and child feeding behaviors, HIV/AIDS knowledge and attitudes, education indicators and availability of community-level health services (*5*). The sample was obtained using a two-stage stratified cluster sampling design (*5*). Details of the sampling design can be found in the 2014 BDHS final report (*5*). The 2014 BDHS includes a household questionnaire, a woman's questionnaire and a community questionnaire (*5*). This study used data collected through the woman's questionnaire. The analysis sample was restricted to 2,953 women who had a birth in the three years preceding the survey and had PNC following delivery.

Variables

There were five binary outcome variables in the study: whether a breast exam was performed (n = 2,944), whether a vaginal discharge exam was performed (n = 2,943), whether a temperature check was performed (n = 2,945), whether counseling on danger signs was given (n = 2,943) and whether all four interventions were performed (n = 2,942), all within two days of birth.

Two potential predictors of PNC interventions used as key covariates in the analyses were the following: the type of provider who performed the PNC; and whether or not the mother had received a cesarean section prior to the most recent birth. Providers who performed the PNC were grouped into four categories: (*1*) qualified doctor/nurse/midwife/paramedic; (*2*) trained and untrained traditional birth attendants; (*3*) unqualified village doctor; and, (*4*) NGO worker and others. Most village doctors are informal providers in the community who have received very minimal training (less than 6 months) by the government and other unofficial private organizations (*20*). Official government training for this cadre of health workers discontinued in 1982 (*20*). The "others" in the NGO worker and others category include community skilled birth attendants, health assistants, family welfare visitors and family welfare assistants. This categorization was used primarily because the majority of these providers are community-based and would be considered "para-professionals" (*18*). Community skilled birth attendants are community-based female field workers who received 6 months of training either by the government or other organizations (*20*). Health assistants received a three-year training to provide primary care alongside doctors at health centers and family welfare centers (*20*). Family welfare visitors received a short 18-month course training by the government and are posted at family welfare centers as well (*20*). Family welfare assistants are community healthcare providers providing basic primary care at community clinics (*20*). Another practical reason for this grouping was that observations for these categories were relatively small (total n=71).

Prior cesarean section was a binary variable with "0" indicating no prior cesarean section and "1" indicating prior cesarean section. This variable was meant to proxy maternal complications during delivery. These women might be more likely to receive follow-up checks than women who had a normal delivery with no complications.

Other covariates included in the models were administrative divisions, residence, age, education, employment, household wealth, parity and number of antenatal visits. Place of delivery was not included as a covariate because it was highly collinear with providers who performed PNC. There are seven administrative divisions or regions in Bangladesh: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet. This information was included in the models as geographic indicators. Residence was a binary variable with "0" indicating urban areas and "1" indicating rural areas. Respondent's age at the time of the survey was recoded to have three categories: "15–24", "25–34" and "35–49". Respondent's education was

recoded to have three categories: "none", "primary education" and "secondary education or higher". Respondent's current employment status was recoded with "1" indicating currently working and "0" indicating not currently working. Household wealth index was initially generated using principal components analysis and was later recoded to have five categories by DHS (*5*): "poorest wealth quintile", "poorer wealth quintile", "middle wealth quintile", "richer wealth quintile" and "richest wealth quintile". Parity was recoded to have four categories: "1", "2", "3" and "4 or more". Finally, number of antenatal visits was recoded as "less than four visits" and "four visits or more".

Analysis

First, a descriptive bivariate analysis was conducted for women who received postnatal care after delivery where sociodemographic variables (age, education, employment, household wealth, parity), residence, administrative divisions and prior use of healthcare services (cesarean section, number of antenatal visits) were stratified by maternal PNC interventions. Then, each intervention of maternal PNC was stratified by providers who performed PNC. Lastly, generalized estimating equations (GEE) models were fit for each of the five binary outcome variables. Due to the nested structure of the data where interviewed respondents were grouped in household clusters (*5*), non-independence of the error terms across units was suspected. GEE adjusts for correlated error terms in the context of group membership (*21*). Mixed models or multilevel models also account for correlations within clusters but impose a distributional assumption on the error term and are relatively more sensitive to model misspecifications (*21*). GEE, however, provides robust estimations that are more flexible to incorrect specification of the error correlation structure (*21*). In addition, GEE is a population-average model in which coefficient estimates are interpreted as the effects of covariates averaged across all household clusters (*21*).

Because the outcome variables are all binary, binomial distribution and a logit link function were specified for all GEE models. The error term correlation structure was specified as exchangeable which allows individual errors within the same cluster to have an identical variance-covariance matrix while errors from different clusters are still assumed to be independent (*21*).

For estimating the effect of providers who performed PNC, prior cesarean section as well as all other covariates previously described in the "Variables" sub-section were included in the GEE models. However, for estimating the effect of cesarean section, providers who performed PNC was excluded from the models due to potential endogeneity. Endogeneity was suspected because having had cesarean section may influence women's choice of their PNC provider. If this is the case, the provider who performed PNC will mediate the effect of cesarean section on the outcomes. Hence, the estimated effect of cesarean section, after removing provider who performed PNC, will be one combining the direct effect of cesarean section on the outcomes and the indirect effect that would have been mediated through the provider who performed PNC. All other covariates remained in the models.

Lastly, all analyses were weighted by the individual women's sampling weights to reflect population-level estimates and missing data imputation techniques were not considered because all models had less than 1% missingness.

RESULTS

Basic sociodemographic characteristics and prior healthcare utilization behaviors for women who received postnatal care were stratified by maternal PNC interventions in **Table 1**, a population-weighted descriptive analysis. A little over a half of these women were between ages 15 and 24 (55.35%), had primary education (51.95%) and were in the richer and richest wealth quintiles (23.32% and 27.20% respectively). In addition, the majority of these women were without employment (75.85%) and lived in rural areas (67.45%). About 36% were living in Dhaka and 22% were living in the Chittagong region (22.00%). In regards

to prior birth experiences, most of these women either had their first or second births in the three years preceding the survey (43.32% and 30.49% respectively), had no prior cesarean section for the most recent delivery (64.05%) and had less than four antenatal visits during the most recent pregnancy (61.67%).

Table 1. Background characteristics by maternal postnatal care interventions (weighted)*

			MATERNAL POSTNATAL CARE INTERVENTIONS‡									
	TOTAL†		BREAST EXAMINATION		EXAMINATION OF VAGINAL DISCHARGE		EXAMINATION OF TEMPERATURE		COUNSELING ON ANGER SIGNS		ALL FOUR INTERVENTIONS	
	N	%	N	%	N	%	N	%	N	%	N	%
Age:												
15–24	1635	55.35%	678	54.82%	653	55.58%	1364	56.09%	912	55.58%	270	53.81%
25–34	1143	38.70%	479	38.79%	446	37.96%	940	38.64%	631	38.43%	198	39.58%
35–49	176	5.95%	79	6.40%	76	6.47%	128	5.28%	98	5.99%	33	6.61%
Education:												
None	743	25.17%	318	25.69%	286	24.34%	594	24.41%	416	25.31%	114	22.73%
Primary	1535	51.95%	623	50.42%	618	52.66%	1272	52.32%	831	50.60%	253	50.55%
Secondary or higher	676	22.88%	295	23.89%	270	23.00%	566	23.27%	395	24.09%	134	26.71%
Employment:												
Yes	713	24.15%	287	23.22%	281	23.93%	594	24.44%	395	24.06%	106	21.19%
No	2240	75.85%	949	76.78%	893	76.07%	1837	75.56%	1246	75.94%	395	78.81%
Wealth:						(*P*<0.05)		(*P*<0.01)				(*P*<0.05)
Poorest	453	15.32%	196	15.82%	168	14.27%	358	14.72%	230	14.00%	59	11.83%
Poorer	475	16.08%	177	14.30%	157	13.34%	377	15.51%	250	15.24%	59	11.72%
Middle	534	18.07%	219	17.73%	207	17.61%	420	17.27%	282	17.18%	90	18.00%
Richer	689	23.32%	276	22.36%	280	23.82%	564	23.20%	404	24.61%	127	25.37%
Richest	803	27.20%	368	29.80%	364	30.96%	713	29.30%	475	28.97%	166	33.08%
Residence:				(*P*<0.05)						(*P*<0.01)		
Urban	962	32.55%	443	35.84%	416	35.41%	820	33.73%	589	35.90%	192	38.25%
Rural	1992	67.45%	793	64.16%	758	64.59%	1612	66.27%	1052	64.10%	309	61.75%
Parity:												
1	1280	43.32%	557	45.05%	516	43.99%	1065	43.79%	705	42.93%	230	45.87%
2	901	30.49%	355	28.71%	348	29.65%	755	31.07%	519	31.59%	154	30.81%
3	428	14.48%	177	14.29%	148	12.58%	325	13.37%	224	13.67%	61	12.11%
4+	346	11.71%	148	11.95%	162	13.79%	286	11.77%	194	11.81%	56	11.21%
C-section:				(*P*<0.01)								(*P*<0.01)
Yes	1062	35.95%	496	40.11%	426	36.29%	899	36.98%	613	37.32%	222	44.28%
No	1892	64.05%	740	59.89%	748	63.71%	1532	63.02%	1029	62.68%	279	55.72%
Antenatal visits:										(*P*<0.05)		(*P*<0.05)
< 4 visits	1819	61.67%	745	60.33%	718	61.21%	1493	61.46%	979	59.69%	271	54.20%
≥ 4 visits	1131	38.33%	490	39.67%	455	38.79%	936	38.54%	661	40.31%	229	45.80%
Administrative divisions:						(*P*<0.001)						(*P*<0.01)
Barisal	159	5.38%	70	5.64%	64	5.43%	139	5.73%	104	6.34%	27	5.31%
Chittagong	650	22.00%	293	23.70%	292	24.86%	531	21.84%	375	22.86%	139	27.74%
Dhaka	1065	36.04%	452	36.55%	457	38.96%	869	35.71%	588	35.82%	193	38.59%
Khulna	258	8.72%	86	6.94%	92	7.84%	202	8.31%	111	6.77%	27	5.44%
Rajshahi	324	10.97%	124	9.99%	96	8.14%	265	10.88%	174	10.60%	26	5.15%
Rangpur	297	10.04%	128	10.34%	84	7.17%	252	10.36%	168	10.21%	47	9.34%
Sylhet	202	6.84%	85	6.84%	89	7.61%	174	7.16%	121	7.39%	42	8.43%

*Columns within a categorical variable sum to 100%. Statistical significance indicated by P-values.
†"Total" column reports the weighted totals for all four interventions performed and not performed.
‡Each column reports the weighted number and frequency of the corresponding intervention being performed.

Bivariate χ^2-tests revealed that PNC interventions were associated with several variables. Rural residence (64.16%) and not having had cesarean section (59.89%) were associated with having a breast exam. Richest wealth quintile (30.96%) and variations in administrative divisions were associated with having a vaginal exam. Richest wealth quintile (29.30%) was also associated with temperature exam. Rural residence (64.10%) and having less than four antenatal visits (59.69%) were associated with counseling on danger signs. Richest wealth quintile (33.08%), not having had cesarean section (55.72%), having less than four antenatal visits (54.20%) and variations in administrative divisions were associated with all four PNC interventions.

Receipt of specific interventions during maternal PNC by type of provider is shown in Table 2. Less than half of women received a breast exam across all types of providers. The proportion of women who did receive a breast exam was noticeably lower among those who had PNC from unqualified doctors (9.16%) relative to other providers. The proportion of women receiving a vaginal discharge exam was considerably lower among those who had contact with unqualified doctors (5.32%), and NGO workers and other community attendants (24.45%), compared to traditional birth attendants (45.23%) and formal providers (41.93%).

Table 2. Maternal postnatal care interventions by health provider (weighted)*

			PROVIDER WHO PERFORMED POSTNATAL CARE							
	TOTAL		DOCTOR/NURSE/MIDWIFE/PARAMEDIC		TRADITIONAL BIRTH ATTENDANT		UNQUALIFIED DOCTOR		NGO WORKER & OTHERS†	
	N	%	N	%	N	%	N	%	N	%
Breast examination (*P*<0.001):										
Yes	1236	41.81%	801	44.51%	352	43.41%	15	9.16%	68	37.68%
No	1721	58.19%	999	55.49%	459	56.59%	151	90.84%	113	62.32%
Examination of vaginal discharge (*P*<0.001):										
Yes	1174	39.72%	755	41.93%	367	45.23%	9	5.32%	44	24.45%
No	1782	60.28%	1045	58.07%	444	54.77%	157	94.68%	137	75.55%
Examination of temperature (*P*<0.05):										
Yes	2432	82.22%	1494	83.01%	679	83.75%	132	79.56%	127	69.99%
No	526	17.78%	306	16.99%	132	16.25%	34	20.44%	54	30.01%
Counseling on danger signs:										
Yes	1641	55.56%	1003	55.79%	432	53.34%	87	52.75%	119	65.74%
No	1313	44.44%	795	44.21%	378	46.66%	78	47.25%	62	34.26%
All four interventions performed (*P*<0.001):										
Yes	501	16.95%	356	19.81%	115	14.18%	6	3.56%	24	13.29%
No	2453	83.05%	1441	80.19%	696	85.82%	160	96.44%	157	86.71%

NGO – non-governmental organization
*Columns within a categorical variable sum to 100%. Statistical significance indicated by P-values.
†"Others" include community skilled birth attendants (CSBAs), health assistants (HAs), family welfare visitors (FWVs), family welfare assistants (FWAs), etc.

The proportion of women checked for temperature was high across all providers, ranging from 69.99% for PNC provided by NGO workers and other community attendants to 83.75% for PNC provided by traditional birth attendants. The proportion of women receiving counseling on danger signs ranged between 52.75% and 55.79%, with the exception of NGO workers and other community attendants who provided counseling at 65.74% of PNC visits.

The proportion of women receiving all four interventions during PNC was very low in general (16.95%). However, the proportion was particularly low among those who received PNC from unqualified doctors (3.56%).

Results from GEE models are presented in Table 3. Compared to the referent category of contact with qualified doctors/nurses/midwives/paramedics, the probability of receiving a breast exam for women who had contact with unqualified doctors was 32.84 percentage points lower, controlling for other factors in the model (see the methods section). The probability of receiving a vaginal discharge exam was 37.65 percentage points lower for women who had contact with unqualified doctors and 18.69 percentage points lower for women who had contact with NGO

workers and other community attendants. The probability of receiving counseling on danger signs was 12.54 percentage points higher for NGO workers and other community attendants and the probability of receiving all four interventions together was 14.80 percentage points lower for unqualified doctors. All of these effects were statistically significant in the models.

Table 3. Results of GEE models

	BREAST EXAMINATION (N=2938)		EXAMINATION OF VAGINAL DISCHARGE (N=2937)		EXAMINATION OF TEMPERATURE (N=2939)		COUNSELING ON DANGER SIGNS (N=2937)		ALL FOUR INTERVENTIONS PERFORMED (N = 2936)	
	DE	95% CI	DE	95% CI	DE	95% CI	DE	95% CI	DE	95% CI
Provider who performed postnatal care.*										
Doctor/Nurse/Midwife/Paramedic (ref)	–	–	–	–	–	–	–	–	–	–
Traditional birth attendant	−0.0072	−0.0728, 0.0584	−0.0229	−0.0833, 0.0375	−0.0127	−0.0593, 0.0339	−0.0116	−0.0769, 0.0538	−0.0461	−0.0972, 0.0051
Unqualified doctor	−0.3284	−0.3929, −0.2639	−0.3765	−0.4255, −0.3275	−0.0097	−0.0838, 0.0645	0.0056	−0.0968, 0.1081	−0.1480	−0.1936, −0.1023
NGO worker & others†	−0.0449	−0.1644, 0.0746	−0.1869	−0.2828, −0.0910	−0.0720	−0.1555, 0.0115	0.1254	0.0168, 0.2339	−0.0449	−0.1193, 0.0295
C-section:‡										
No (ref)	–	–	–	–	–	–	–	–	–	–
Yes	0.0867	0.0313, 0.1421	−0.0052	−0.0499, 0.0395	0.0402	0.0069, 0.0735	0.0381	−0.0162, 0.0924	0.0531	0.0147, 0.0916

GEE – generalized estimating equations (binomial was specified for family, logit was specified for link, exchangeable was specified for correlation structure and individual probability weights were used), DE – differential effect which is the difference in the average predicted probabilities between the reference category and the comparison category, NGO – non-governmental organization, CI – confidence interval

*Covariates included in the models were c-section, age, education, employment, household wealth, parity, number of antenatal visits, residence and administrative divisions.

†"Others" include community skilled birth attendants (CSBAs), health assistants (HAs), family welfare visitors (FWVs), family welfare assistants (FWAs), etc.

‡Estimates for "C-section" were obtained from the reduced models excluding "Person who Performed Postnatal Care" (all other covariates remained in the models).

The effects of having had cesarean section in the reduced models, where the provider who performed PNC was excluded, were statistically significant for a few outcomes. Compared to the referent category of not having had cesarean section, women who had prior cesarean section had 8.67 percentage points higher probability of receiving breast examination, 4.02 percentage points higher probability of receiving examination of temperature and 5.31 percentage points higher probability of receiving all four interventions, controlling for other factors included in the models (see the methods section).

DISCUSSION

PNC is recognized as an important strategy to reduce maternal mortality. In order to fully understand the coverage and quality of PNC, we need to know the content. This is among the first studies to use household survey data to study the content of PNC and to do this by provider type. Many low- and middle-income countries are facing a shortage of qualified health care workers, thus understanding coverage of PNC interventions by provider type is warranted.

First, the bivariate analysis revealed that poor women were less likely to receive important interventions during PNC compared to their more wealthy counterparts. Women who live in the Dhaka and Chittagong regions were much more likely to receive all four PNC interventions compared to those who live in other regions. These findings highlight the need for continued attention in increasing accessibility and availability of key interventions during PNC for all women regardless of their wealth or where they live.

The bivariate analysis of PNC interventions revealed that less than half of women received either a breast or vaginal discharge examination, and a little over one-half received counseling on danger signs. A large majority of women had their temperature checked. Only a small proportion received all four PNC interventions. Considering that the global recommendation is to provide these four and more PNC interventions for all women (*6*), the Government of Bangladesh should consider ways to improve the coverage and quality of the full PNC package.

Findings from the GEE models further hint at where programs might target their resources and efforts. Compared to having contact with qualified doctors/nurses/midwives/paramedics, women who had contact with unqualified doctors had lower probability of receiving examinations for breasts, vaginal discharge and all four interventions. NGO workers and other community attendants had lower probability of receiving examination of vaginal discharge. Traditional birth attendants had statistically similar probabilities of receiving each examination and all four interventions together relative to qualified doctors/nurses/midwives/paramedics. However, it is important to note that the frequencies of PNC contact with unqualified village doctors and NGO workers and community attendants were much lower at 5.6% and 6.5% respectively (not shown in the tables). Hence, from a population perspective, only a small proportion of women are subject to lower probabilities of receiving certain PNC interventions due to contact with these providers. Nonetheless, considering that the receipt of most examinations by qualified doctors were not high to begin with, all types of providers need to be reminded of the importance of performing the full package of essential PNC on all women.

Addressing relatively lower receipt of examinations by unqualified doctors can include at least two programmatic approaches. The first approach is to raise general awareness about the importance of performing all of the examinations necessary during a PNC visit. Because unqualified doctors predominantly operate in rural home and community settings (*18*), such awareness-raising campaigns and training sessions should be done at the village and community levels. The second approach which should run parallel to the first approach is to encourage women and families to seek PNC contact with more qualified community attendants or with highly-trained health providers. It may be unlikely in the short term, however, that women whose first choice was to seek PNC with unqualified attendants will switch to seeking postnatal contact with highly-trained health providers. This is especially true when there is an overall shortage and an inequitable distribution of the skilled health workforce in Bangladesh (*18*, *19*). Due to such disproportionate distribution of skilled health providers, there has been evidence of unqualified village doctors being the primary source of care for various illnesses in rural areas of Bangladesh. For example, a study in Chakaria, a rural area in Bangladesh, found that among residents who sought treatment for their various reported illnesses, 46% of them consulted unqualified village doctors as their primary and only source of care (*19*). The study concluded that because the inequitable distribution of qualified health providers is unlikely to shift in the near term, unqualified village doctors with proper training could hold promise as complementary frontline primary healthcare providers in the future (*19*).

In addition to the supply-side challenges, there could also be demand-side challenges such as geographic and financial burden (*7*) as well as cultural pushback against seeking facility-based providers soon after delivery (*15*). Hence, in the near term, encouraging women to seek PNC with already-skilled community attendants while simultaneously investing in the training of more community attendants and unqualified village doctors seems to be an appealing option (*18*, *19*).

Lastly, women who had prior cesarean section had a higher probability of receiving a breast exam, temperature check and all four interventions together, possibly suggesting that providers are performing these examinations differentially based on history of complications rather than performing these examinations on all women. This finding also reiterates the need for reminding and in some cases, re-training providers to perform all necessary PNC interventions for all women in Bangladesh.

There were a few limitations in the study. First, we were not able to parse out NGO workers with as much heterogeneity as desired. The grouping of different types of community attendants under a single category of "others" was done because there were not enough observations in each type for meaningful statistical analysis. For this reason, readers are warned to interpret findings related to this group with a degree of caution.

Second, recall bias could be an issue. Several large-scale validation studies of maternal, newborn and child health indicators included testing of PNC interventions for women. A study in China compared women's reports with health records and found that the measures included in the

study had moderate validity (*22*). These measures included assessments of blood pressure and temperature; and exams of the breast, uterus, lochia and perineum (*22*). A study in Mozambique compared observations to women's recall and found that fundal massage after delivery of the placenta could be reported by women, but that blood pressure assessment after delivery was not accurately reported (*23*). Several measures of PNC for women were included in a study in Kenya (*24*) and in Mexico (*25*). These measures included palpation of the uterus after delivery; and checks for bleeding, for blood pressure, of the perineum, temperature, and involution (return of uterus to normal size) (*24*, *25*). The measures varied on assessments for validity. As a sensitivity analysis to examine the potential effect of recall bias, this study also looked at the sub-population of those who gave birth in the past one year from the time of the survey compared to the population of women who gave birth in the past three years (not shown in the tables). The conclusions were largely the same. The only glaring difference in the GEE analyses was that women who had PNC contact with NGO workers and other community attendants did not have a statistically different probability of receiving examination of vaginal discharge relative to women who had contact with doctors, nurses, midwives and paramedics. In addition, the proportions receiving PNC interventions were slightly higher for PNC contact with NGO workers and other community attendants and slightly lower for PNC contact with unqualified village doctors. Considering that the overall conclusions do not change between different recall periods, recall bias may not have been a significant issue in our analyses. However, recall bias still remains an ongoing concern in the data collection process and demands new ways to address it.

A qualitative study in Ghana revealed insights into the importance of communication between health workers and patients (*26*). Women in the study described how health workers did not explain the checks they conducted, and many women were unaware of the purpose of some of the equipment, such as thermometers, used during the checks (*26*). This study reveals the importance of improved communication in efforts to improve the validity of PNC signal functions for women (*26*). Recommendations coming from the study also included careful timing of interviews to improve recall and describing or showing equipment to women such as thermometers to help improve recall of whether specific checks were done (*26*).

CONCLUSIONS

Despite some limitations in the study, the main findings of this paper are very informative, especially in program development and policy formulation in Bangladesh. The main findings suggest that provision of specific interventions during PNC needs to improve across all providers, but particularly among unqualified doctors. In addition, all women, regardless of their sociodemographic background, region of residence and prior births and complications, should be provided the full package of PNC interventions. Training all cadres of health providers is an important first step in efforts to reach all women with high quality PNC. Finally, more household surveys and programs should observe and analyze the content of PNC to understand the quality of a PNC visit, and not just whether or not a visit occurred. This will be helpful in evaluating the effective coverage of PNC, which could more accurately describe the current situation of service delivery by assessing need, access and quality altogether (*27*).

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