Coverage and Determinants of Infant Postnatal Care in Nigeria: a Population-based Cross-sectional Study

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Abstract

Background: In 2019, Nigeria had the most under-5 child deaths globally, many of which occurred within the neonatal period, especially in the first week after birth. Despite the effectiveness of infant postnatal care (PNC) attendance recommended by the World Health Organization (WHO), this problem persists. Therefore, the study examined coverage and determinants of infant PNC attendance in Nigeria.

Methods: Nigeria Demographic Health Survey (NDHS) 2018 data were used to evaluate infant PNC coverage and determinants. Infant PNC was defined as receipt of care within two days of birth. Children delivered up to two years before the 2018 NDHS were included. We examined predictors of infant PNC with Poisson regression models to estimate relative risks (RR).

Results: The national coverage of infant PNC was 37.3% (95% CI: 35.8%–38.7%). Significant heterogeneity in PNC attendance exists at state and regional levels. Facility delivery was strongly associated with uptake of PNC (RR: 6.07; 95% CI: 5.60–6.58). Greater maternal education, maternal employment, urban residence, female head of household, and greater wealth were also associated with increased likelihood of PNC visits.

Conclusions: Uptake of infant PNC in Nigeria is low. Interventions are urgently needed to promote equity in access and increase demand.

Introduction

It is estimated that there are 2.5 million deaths among children under age five each year, almost half (47%) of which occur during the neonatal period (first 28 days of life)^{1–2}. Among neonatal deaths, about one third occur on the first day of life and this increases to close to three quarters by the early neonatal period within the first week of life^{1–2}. Neonatal deaths can relate to conditions and diseases associated with lack of quality care at birth, and to limitations in skilled care and treatment immediately after birth and in the first days of life. Preterm birth, intrapartum-related complications (e.g., birth asphyxia), infections and congenital anomalies are leading causes of neonatal death². In Nigeria, between 2008 and 2018, child under-5 and infant mortality rates declined considerably; 157 to 132 per 1000 livebirths and 75 to 67/1000 livebirths, respectively, however, neonatal deaths hardly declined from 40 to 39/1000 livebirths during the same period³. We were motivated to examine neonatal care for this reason.

The World Health organization WHO recommends at least four postpartum and postnatal care (PNC) visits for mothers and infants, respectively, within the first six weeks after delivery. These four visits are recommended within the first 24 hours, on day 3 (48–72 hours), between days 7–14, and at six weeks. However, given the significance of the first two days of life in relation to child survival, the global indicator for monitoring PNC coverage in Demographic Health Surveys (DHS) and other nationally representative surveys is the receipt of infant PNC within two days of delivery^{1–3}, which includes the WHO-recommended window of 24 hours and allows an additional day. For this reason we defined our outcome variable of interest as a PNC visit within the first two days.

The Sustainable Development Goals (SDGs) call on all countries to reduce neonatal mortality to less than 12 per 1,000 live births and under-five mortality less than 25 per 1,000 live births by 2030⁴. To meet this goal Nigeria will need to expand coverage of interventions to improve neonatal survival^{1, 5}. The postnatal period is defined the time immediately after birth up to 6 weeks of life^{6–7}. The World Health Organization (WHO) has recommended infant PNC since 1997 [7] and has since reiterated the importance of postnatal care in the first weeks of life in reducing infant morbidity and mortality^{8,9}. Typically, postnatal visits focus on screening for and counseling on maternal and neonatal danger signs, as well as encouragement and reinforcement of breastfeeding, skin-to-skin contact, newborn immunization, and emphasizing the importance of prompt care-seeking. Although previous studies^{10–12} have reported the benefits of PNC for both mothers and neonates, few analysts have evaluated the determinants that influence mothers to seek infant PNC^{13–15}.

In this study we assessed national and state coverage of infant PNC to identify population-level patterns of uptake of infant PNC. We also evaluated the association of individual-level household, maternal, and infant factors with uptake of infant PNC. This

study is intended to identify populations with low coverage of infant PNC and modifiable individual-level factors to inform the design of interventions to promote infant PNC in Nigeria.

Method

Data source and sampling

The study utilized data from the 2018 Nigeria Demographic Health Survey (NDHS) to assess the coverage and determinants of infant PNC within two days after birth. Official permission to analyze the 2018 NDHS data was sought and obtained from the DHS program³. The 2018 NDHS was a nationally representative household survey that collected data on demographic and health indicators from all 36 states and the Federal Capital Territory. The NDHS used a stratified two-stage cluster sampling design with stratification by urban / rural area. A total of 1,400 enumeration areas (EAs) were selected with probability proportional to size sampling (PPS) and 30 households were randomly selected in each cluster. Women aged 15-49 and men aged 15-59 were the target groups for the survey in the selected households. The complete details of the sampling methods are found in the NDHS 2018 report³.

Study population

The NDHS collected data on all children under 5 years of age residing in selected households; however, collection of data on PNC was limited to births within the two years of the time of the survey. Formerly, DHS had assessed PNC coverage all live births within the five years preceding the survey; however, the period covered by PNC questions has been reduced to two years in an attempt to minimize the risk of recall bias¹. All live births within two years of the survey were included in the study, regardless of facility or non-facility delivery and cesarean or vaginal birth. The analytic sample in the study included 12,945 livebirths.

Outcome variable

The global consensus indicator for monitoring infant PNC coverage is postnatal check within 2 days after childbirth^{1,3}. In this analysis, the primary outcome—postnatal check within 2 days, regardless of type of provider—was derived from three different variables; provider of first check, timing of first check, and the amount of elapsed time from delivery to the postnatal check. Information were made available through card and maternal report. All live births within 2 years prior to the 2018 NDHS were included in the study.

Explanatory variables

The explanatory variables for the study were selected before the analysis based on the literature and included characteristics related to the mothers, newborns, and the household. Characteristics of mothers included maternal age in years, marital status, mother's educational level, health insurance status, employment, religion, and ethnicity. Place of delivery, sex, multiple birth, birth order and type of birth (cesarean or vaginal) were included as newborn characteristics while region, urban/rural residence, sex of the household head, wealth quintiles and perception on distance to facility were included as household characteristics.

Mother's age in years, was classified into three categories <20, 20–34 and 35–49 years. Marital status was classified by never in union, married/living with partner, and widowed/divorced/separated while maternal education has four levels that included no formal education, primary, secondary, and higher education. Health insurance and employment status were determined by maternal report of a yes or no response. As for religion, the categories were as presented in line with the NDHS report: Catholic, other Christian denomination, Islam, Traditionalist, and Others.

As a proxy for access to care, we included maternal report of whether the distance from the home to the health facility was 'a big problem' or not. Place of delivery was defined by institutional and non-institutional delivery. Birth order was categorized into four categories first, second and third, fourth and fifth, and sixth and above. Household wealth quintiles were directly coded from the 2018 NDHS and were calculated based on ownership of materials and household characteristics using principal component analysis.

Statistical analysis

First, descriptive statistics of mothers, newborns and households were calculated for the analytic sample for livebirths that occurred within 2 years of the survey. Second, we calculated the proportion of newborns who received PNC within 2 days nationally and in the 36 States and the Federal Capital Territory; the analysis accounted for stratification and cluster sampling. Third, we examined predictors of PNC in univariable and multivariable Poisson regression models to estimate relative risks¹⁶. The primary multivariable models included all explanatory variables of interest. A sensitivity analysis of the multivariable model excluding ethnicity and region was also conducted. All analyses were conducted in Stata version 12¹⁷.

Results

The study sample included data from 12,945 livebirths that occurred during the two years prior to the 2018 NDHS. Table 1 shows characteristics of the study sample. Of note, most mothers were within 20–34 years of age (72.4%), 94.9% were married or living with a partner, 43.7%, had no formal education and only 2.1% of mothers reported to have health insurance. About two-thirds of mothers perceived that distance from the home to the health facility to access medical help was ‘not a big problem’. As for newborns, 97.2% were singletons, 18.7% were firstborns and 28.9% were delivered at an institutional facility.

Table 1
Characteristics of mother, infants and households in the sample of livebirths within
two years of the 2018 NDHS (N=12,945)

Characteristics	n (%)
Maternal age (in years)	
< 20	797 (6.2)
20-34	9372 (72.4)
35-49	2776 (21.4)
Current marital status	
Never in union	343 (2.7)
Married/living with partner	12279 (94.9)
Widowed/Divorced/Separated	323 (2.5)
Maternal educational level	
No education	5652 (43.7)
Primary	1922 (14.8)
Secondary	4334 (33.5)
Higher	1037 (8.0)
Mother has health insurance	
No	12670 (97.9)
Yes	275 (2.1)
Mother currently working	
No	4343 (33.6)
Yes	8602 (66.4)
Place of residence	
Urban	4482 (34.6)
Rural	8463 (65.4)
Religion of mother	
Catholic	1192 (9.2)
Other Christian	3998 (30.9)
Islam	7646 (59.1)
Traditionalist	43 (0.3)
Other	66 (0.5)
Getting medical help for self (Mother): Distance to health facility	
Big problem	4343 (33.6)
Not a big problem	8602 (66.5)

Characteristics	n (%)
Ethnicity of mother	
Hausa	4056 (31.3)
Fulani	1234 (9.5)
Ekoi	69 (0.5)
Ibibio	194 (1.50)
Igala	120 (0.9)
Igbo	1733 (13.4)
Ijaw/Izion	333 (2.6)
Kanuri/Beriberi	316 (2.4)
Tiv	322 (2.5)
Yoruba	1248 (9.6)
Other	3308 (25.6)
Don't know	12 (0.1)
Sex of child	
Male	6563 (50.7)
Female	6382 (49.3)
Birth order	
First	2415 (18.7)
Second/Third	4377 (33.8)
Fourth/Fifth	3109 (24.0)
Sixth and above	3044 (23.5)
Place of delivery	
Non-institutional	7674 (59.3)
Institutional	5271 (40.7)
Type of birth	
Singleton	12579 (97.2)
Multiple birth	366 (2.8)
Sex of household head	
Male	11738 (90.7)
Female	1207 (9.3)
Household wealth quintiles	
Poorest	3005 (23.2)
Poorer	2937 (22.7)
Middle	2735 (21.1)
Richer	2399 (18.5)
Richest	1869 (14.4)

Characteristics	n (%)
Region	
North Central	2308 (17.8)
North East	2760 (21.3)
North West	3752 (29.0)
South East	1446 (11.2)
South South	1311 (10.1)
South West	1368 (10.6)

The national coverage of newborns receiving PNC within 2 days of birth was 37.3% (95% CI: 35.8, 38.7). Among those who completed PNC visits, mothers reported 10.4% were seen by doctors, 19.7% by nurse/midwife, 1.1% were seen by other health workers and 68.8% were either not seen at all or were seen by non-health professionals. There was high variability in the coverage of PNC by region (Figure 1 and Supplemental Table 1); Kebbi state had the lowest PNC coverage at 5.9% and Osun state had the highest coverage at 80.6%. As shown in the map in Figure 1, the states in the Southwest region had the highest coverage while states in the North West region had the lowest coverage.

Table 2 presents the coverage of PNC within 2 days of birth by maternal, newborn, and household characteristics. Of note, the coverage of PNC had high variation by maternal education with 16.0% (95% CI: 15.0, 17.1%) coverage for mothers with no formal education and 76.2% (95% CI: 73.0%, 72.8%) for mothers with higher education. Wealth quintile had similarly large variation with 15.0% coverage for the poorest household quintile and 70.4% for the richest quintile. Coverage of PNC was also significantly higher in urban areas as compared to rural areas (55.7% vs 25.4%). Facility births had significantly higher coverage of PNC at 77.3% as compared to 9.8% for non-facility deliveries.

Table 2

Coverage proportion and 95% confidence interval of newborns who received a postnatal care within 2 days of delivery by maternal, baby and household characteristics (N=12,945)

Maternal, baby and household characteristics (N=12,743)			
Characteristics	n	Percent of infants who received a postnatal check within 2 days of delivery (95% CI)	P-value
Maternal age (in years)			
< 20	797	26.7 (23.4, 30.3)	<0.001
20-34	9372	37.6 (36.4, 38.7)	
35-49	2776	39.2 (37.0, 41.4)	
Current marital status			
Never in union	343	50.9 (43.5, 58.2)	<0.001
Married/living with partner	12279	36.8 (35.7, 37.8)	
Widowed/Divorced/Separated	323	44.0 (37.7, 50.5)	
Maternal educational level			
No education	5652	16.0 (15.0, 17.1)	<0.001
Primary	1922	37.2 (34.5, 40.0)	
Secondary	4334	55.4 (53.7, 57.2)	
Higher	1037	76.2 (73.02, 79.1)	
Mother covered by health insurance			
No	12670	36.6 (35.6, 37.7)	<0.001
	275		
Yes		66.8 (60.1, 72.8)	
Religion			
Catholic	1192	59.2 (56.0, 62.3)	<0.001
Other Christian	3998	56.5 (54.7, 58.3)	
Islam	7646	25.5 (24.4, 26.7)	
Traditionalist	43	22.4 (11.3, 39.3)	
Other	66	8.2 (3.2, 19.4)	
Mother currently working			
No	4343	27.3 (25.7, 28.9)	<0.001
Yes	8602	42.2 (41.0, 43.5)	
Place of residence			
Urban	4482	55.7 (54.0, 57.5)	<0.001
Rural	8463	25.4 (24.4, 26.5)	

Characteristics	n	Percent of infants who received a postnatal check within 2 days of delivery (95% CI)	P-value
Ethnicity			
Hausa	4056	17.7 (16.5, 19.1)	<0.001
Fulani	1234	20.6 (18.2, 23.2)	
Ekoi	69	43.2 (31.2, 55.9)	
Ibibio	194	45.8 (38.2, 53.7)	
Igala	120	60.6 (50.6, 69.8)	
Igbo	1733	65.7 (63.0, 68.2)	
Ijaw/Izon	333	30.6 (24.8, 37.0)	
Kanuri/beriberi	316	28.2 (22.6, 34.6)	
Tiv	322	48.0 (42.0, 54.1)	
Yoruba	1248	71.1 (67.3, 74.6)	
Other	3308	40.4 (38.4, 42.3)	
Don't know	12	49.4 (22.3, 76.8)	
Getting medical help for self (Mother): Distance to health facility			
Big problem	4343	29.8 (28.1, 31.5)	<0.001
Not a big problem	8602	40.2 (39.0, 41.4)	
Place of delivery			
Non-institutional	7674	9.8 (9.0, 10.5)	<0.001
Institutional	5271	77.3 (75.9, 78.6)	
Sex of child			
Male	6563	38.5 (37.1, 39.9)	0.02
Female	6382	36.0 (34.6, 37.4)	
Birth order of baby			
First	2415	46.7 (44.3, 49.2)	<0.001
Second/Third	4377	42.1 (40.3, 43.8)	
Fourth/Fifth	3109	35.6 (33.7, 37.6)	
Sixth and above	3044	24.4 (22.7, 26.2)	
Type of birth			
Singleton	12579	37.5 (36.5, 38.5)	<0.001
Multiple birth	366	27.4 (22.3, 33.1)	
Sex of household head			
Male	11738	35.8 (34.8, 36.8)	<0.001
Female	1207	52.8 (49.5, 56.0)	

Characteristics	n	Percent of infants who received a postnatal check within 2 days of delivery (95% CI)	P-value
Wealth quintiles			
Poorest	3005	15.0 (13.7, 16.5)	<0.001
Poorer	2937	21.1 (19.5, 22.7)	
Middle	2735	36.3 (34.3, 38.4)	
Richer	2399	53.4 (51.0, 55.9)	
Richest	1869	70.4 (67.7, 73.0)	
Region			
North Central	2308	40.7 (38.4, 43.0)	<0.001
North East	2760	30.2 (28.2, 32.3)	
North West	3752	16.0 (14.7, 17.3)	
South East	1446	64.7 (61.9, 67.4)	
South South	1311	44.9 (41.7, 48.1)	
South West	1368	73.0 (69.6, 76.1)	

Table 3 presents univariable and multivariable models for predictors of postnatal ANC coverage within 2 days of birth. In univariable models all predictors, except for child sex were associated with PNC coverage (p-values <0.05). In the primary multivariable model, greater maternal education, maternal employment, singleton births, urban residence and greater wealth were associated with increased likelihood of having a PNC visit (p-values <0.05). Of note, facility deliveries had over six times the likelihood of having a PNC visit as compared to non-facility deliveries (RR: 6.07; 95% CI: 5.60–6.58). In addition, religion was associated with PNC coverage with Catholics having the highest likelihood of PNC. Further independent of the maternal, newborn, and household characteristics examined, ethnicity and region was associated with PNC in the primary multivariable model. In the primary multivariable model, maternal age, marital status, maternal health insurance, perceived distance to health facility, child sex, and birth order were not significantly associated with PNC coverage (p-values >0.05).

Table 3

Univariable and multivariable Poisson regression models to estimate the relative risk of PNC within two days of delivery by maternal, newborn, and household characteristics

Characteristics	N	Univariable relative risk 95% CI	p-value	Multivariable relative risk (95% CI)	p-value	Sensitivity analysis-multivariable relative risk excluding region & Ethnicity	p-value
Maternal age (in years)							
< 20	797	Reference		Reference		Reference	
20-34	9372	1.28 (1.15, 1.44)	<0.001	0.93 (0.85, 1.02)	0.11	0.95 (0.87, 1.04)	0.24
35-49	2776	1.25 (1.20, 1.52)	<0.001	0.97 (0.88, 1.07)	0.58	1.01 (0.91, 1.11)	0.87
Current marital status							
Never in union	343	Reference		Reference		Reference	
Married/living with partner	12279	0.81 (0.72, 0.91)	<0.001	0.97 (0.89, 1.07)	0.05	0.97 (0.88, 1.07)	0.58
Widowed/Divorced/Separated	323	0.92 (0.77, 1.09)	0.34	1.01 (0.89, 1.16)	0.29	1.01 (0.88, 1.15)	0.97
Maternal educational level							
No education	5652	Reference		Reference		Reference	
Primary	1922	2.32 (2.14, 2.52)	<0.001	1.19 (1.11, 1.28)	<0.001	1.21 (1.12, 1.30)	<0.001
Secondary	4334	3.37 (3.16, 3.60)	<0.001	1.24 (1.15, 1.32)	<0.001	1.24 (1.16, 1.33)	<0.001
Higher	1037	4.61 (4.30, 4.94)	<0.001	1.22 (1.12, 1.31)	<0.001	1.23 (1.14, 1.32)	<0.001
Mother has health insurance							
No	12670	Reference		Reference		Reference	
Yes	275	1.80 (1.65, 1.97)	<0.001	1.07 (0.99, 1.15)	0.13	1.03 (0.96, 1.10)	0.44
Mother currently working							
No	4343	Reference		Reference		Reference	
Yes	8602	1.52 (1.44, 1.60)	<0.001	1.10 (1.05, 1.15)	<0.001	1.13 (1.08, 1.17)	<0.001
Getting medical help for self (Mother): Distance to health facility							
Big problem							
Not a big problem	4343	Reference		Reference		Reference	
	8602	1.42 (1.33, 1.50)	<0.001	0.97 (0.93, 1.02)	0.25	0.96 (0.92, 1.00)	0.06
Religion							
Catholic	1192	Reference		Reference		Reference	

Other Christian	3998	0.93 (0.88, 0.98)	0.009	0.96 (0.84, 0.95)	0.08	1.04 (0.99, 1.08)	0.12
Islam	7646	0.44 (0.42, 0.47)	<0.001	0.94 (0.82, 0.96)	0.06	1.02 (0.97, 1.08)	0.38
Traditionalist	43	0.36 (0.20, 0.65)	0.001	0.84 (0.46, 1.39)	0.51	0.85 (0.52, 1.40)	0.53
Other	66	0.13 (0.06, 0.30)	<0.001	0.20 (0.08, 0.39)	<0.001	0.24 (0.11, 0.51)	<0.001
Ethnicity							
Hausa	4056	Reference		Reference			
Fulani	1234	1.19 (1.05, 1.34)	0.006	1.03 (0.92, 1.15)	0.62		
Ekoi	69	2.32 (1.75, 3.09)	<0.001	0.73 (0.58, 0.93)	0.01		
Ibibio	194	2.39 (2.01, 2.85)	<0.001	1.24 (1.03, 1.50)	0.02		
Igala	120	3.36 (2.87, 3.94)	<0.001	1.10 (0.97, 1.24)	0.14		
Igbo	1733	3.54 (3.29, 3.82)	<0.001	0.93 (0.84, 1.04)	0.20		
Ijaw/Izon	333	1.59 (1.33, 1.91)	<0.001	1.02 (0.86, 1.21)	0.85		
Kanuri/beriberi	316	1.38 (1.13, 1.69)	0.002	1.06 (0.88, 1.26)	0.54		
Tiv	322	2.44 (2.12, 2.80)	<0.001	0.87 (0.76, 1.00)	0.06		
Yoruba	1248	4.03 (3.74, 4.34)	<0.001	1.01 (0.96, 1.12)	0.72		
Other	3308	2.13 (1.97, 2.31)	<0.001	0.94 (0.86, 1.03)	0.19		
Don't know	12	3.22 (1.99, 5.22)	<0.001	1.01 (0.64, 1.59)	0.97		
Place of delivery							
Non-facility	7674	Reference		Reference		Reference	
Facility	5271	7.59 (7.09, 8.13)	<0.001	6.07 (5.60, 6.58)	<0.001	6.21 (5.73, 6.72)	<0.001
Sex of child							
Male	6563	Reference		Reference		Reference	
Female	6382	0.97 (0.93, 1.02)	0.21	0.98 (0.95, 1.01)	0.18	0.97 (0.94, 1.01)	0.11
Baby birth order							
First	2415	Reference		Reference		Reference	
Second/Third	4377	0.89 (0.84, 0.94)	<0.001	1.01 (0.96, 1.05)	0.78	1.00 (0.96, 1.04)	0.94
Fourth/Fifth	3109	0.79 (0.74, 0.84)	<0.001	1.04 (0.99, 1.09)	0.16	1.02 (0.96, 1.07)	0.55
Sixth and above	3044	0.54 (0.50, 0.59)	<0.001		0.42		0.71

				1.03 (0.96, 1.10)		0.99 (0.92, 1.06)	
Type of birth							
Singleton	12579	Reference		Reference		Reference	
Multiple birth	366	0.70 (0.59, 0.83)	<0.001	0.53 (0.45, 0.63)	<0.001	0.54 (0.46, 0.63)	<0.001
Place of residence							
Urban	4482	Reference		Reference		Reference	
Rural	8463	0.50 (0.48, 0.52)	<0.001	0.94 (0.91, 0.98)	0.001	0.93(0.89, 0.96)	<0.001
Sex of household head							
Male	11738	Reference		Reference		Reference	
Female	1207	1.43 (1.35, 1.52)	<0.001	1.04 (0.99, 1.09)	0.10	1.05 (1.00, 1.10)	0.06
Wealth quintiles							
Poorest	3005	Reference		Reference		Reference	
Poorer	2937	1.48 (1.33, 1.65)	<0.001	1.05 (0.96, 1.14)	0.28	1.03 (0.94, 1.13)	0.45
Middle	2735	2.50 (2.27, 2.75)	<0.001	1.14 (1.05, 1.24)	0.002	1.13 (1.04, 1.23)	0.003
Richer	2399	3.48 (3.17, 3.81)	<0.001		<0.001		<0.001
Richest	1869	4.54 (4.15, 4.96)	<0.001	1.20 (1.10, 1.31)	<0.001	1.20 (1.11, 1.31)	<0.001
				1.23 (1.13, 1.35)		1.24 (1.14, 1.35)	
Region							
North Central	2308	Reference		Reference			
North East	2760	0.66 (0.61, 0.71)	<0.001	1.10 (1.03, 1.18)	0.004		
North West	3752	0.37 (0.34, 0.41)	<0.001		<0.001		
South East	1446	1.50 (1.40, 1.59)	<0.001	0.83 (0.76, 0.91)	0.64		
South South	1311	1.00 (0.92, 1.08)	0.97	0.98 (0.90, 1.06)	0.42		
South West	1368	1.74 (1.64, 1.84)	<0.001	1.03 (0.96, 1.10)	<0.001		
				1.12 (1.06, 1.19)			

We conducted a sensitivity analysis excluding ethnicity and region from the multivariable model (Table 3). There were no qualitative changes in factors associated with PNC; however, the magnitude of the significant predictors tended to be stronger when excluding ethnicity and region.

Discussion

We found that the national average coverage of infant PNC in Nigeria was low at 37.3% among infants and that coverage varied significantly by state. The lowest coverage was found in Kebbi state with approximately 1 in 20 infants attending infant PNC; the highest coverage was in Osun state where 4 of 5 infants attended PNC. We also identified several individual-level maternal, child

and household characteristics that were associated with receipt of PNC. We found that higher maternal education, mothers who were employed, facility deliveries, singleton births, living in urban setting, and higher household wealth were associated with infant PNC attendance.

Most previous studies have evaluated maternal postpartum care coverage^{14–15, 18–21, 24–27} however, the present study examined the coverage of infant PNC. As has been observed in this study, mothers' educational level, residence, place of delivery and wealth quintiles were all also found to be associated with uptake of maternal postpartum care. Infant PNC includes important interventions, such as clinical examination, counselling, immunization and anthropometric assessments. As a result, infants who do not attend PNC do not receive multiple survival interventions. We found significant regional- and state-level variation in uptake of infant PNC and these variations are generally aligned with differences in under-5 mortality in Nigeria^{28–29}. In Nigeria, regional diversity in the utilization of maternal services in particular maternal PNC has also been reported in other studies^{14–15, 21}. The differences in the utilization of PNC may be due to regional specific factors but also differences in the distribution of individual-level risk factors that are related to uptake of the service between regions. For example, mothers from the southern region are more likely to be more educated and deliver their babies in institutionalized facilities compared to their counterparts in the northern region of the country and we found education and institutional delivery were amongst the strongest risk factors for receipt of infant PNC. As a result, interventions to promote infant PNC in Nigeria should consider the regional and local context in terms of risk factors and enablers to infant PNC uptake.

At the individual-level, we found that greater maternal education was observed to be associated with increased uptake of infant PNC. This finding agrees with previous studies that found significant association between uptake of maternal PNC and mothers' level of education^{10–11, 14–15, 22–24}. It seems reasonable that mothers with higher education may have greater knowledge on the importance of infant PNC. In addition, higher level of education can be associated with employment, financial autonomy¹⁴, living in urban settings¹⁵ and may also contribute to increased likelihood of utilization of health services such as the infant PNC. Similarly, we found that uptake of PNC was associated with greater household wealth. This finding agrees with results from other studies in Africa^{14–15, 21, 18–20}. Greater wealth may offer resources and support for travel to health centers, and likely correlates positively with education, employment, and other beneficial characteristics. It appears important that interventions to promote infant PNC consider knowledge and access barriers for women with low education and fewer resources.

In addition, we found that institutional delivery was a strong predictor of receipt of PNC in the first two days of life. In Nigeria, home delivery is common; in our sample over half (59.3%) of women did not deliver in a facility. Previous studies have also reported strong association between institutional delivery and receipt of maternal PNC in Nigeria^{14–15, 21}. Our findings are also consistent with previous study in Uganda that also found facility delivery was associated with utilization of infant PNC within two days of delivery¹³. Women who delivered at health facilities have demonstrated access and trust in the health system, and thus it is not unexpected these women are likely to return for their postnatal care. However, we note that almost a quarter of women who did deliver in a facility did not return for PNC. It is important to understand why this is happening. In general, interventions that promote institutional deliveries are likely to support uptake of infant PNC, nonetheless. Further, interventions that also improve quality of prenatal and delivery care may further increase rates of infant PNC for women who deliver in a facility.

Living in rural areas was found to be associated with a lower likelihood of utilization of infant PNC as compared to residing in urban areas. This finding is in line with evidence on the rural-urban disparities in health service utilization in Nigeria and other settings^{14–5, 21}. Rural areas represent the most deprived settlement in terms of social amenities including availability of health services. As have been observed in previous studies in Nigeria and other parts of Africa,^{14–15, 20–21, 24–27} rural populations have lower education and higher levels of poverty which are important determinants of health care utilization. Living in rural area was also associated with a lesser odd of uptake of infant PNC in a study done in Indonesia³⁰. Furthermore, we found that neonates from multiple births were observed in our study to have a lower likelihood of using PNC compared to neonates from singleton birth, despite higher risk of morbidity including disability that have been associated with multiple births³¹ compared to singletons. We hypothesize that mothers who had multiple births may require additional resources, for example money for food, supplies, and transport, household help, and other forms of labor. Also, mothers delivering multiple children may experience additional pregnancy complications that make travel difficult.

This study has several limitations. First, PNC coverage was collected using health cards and maternal report and therefore there may be some degree of misclassification. Nevertheless, we expect the misclassification may be non-differential to our exposures of interest which would result in us underestimating the true association. Further, due to social desirability some mothers may over-report infant PNC attendance. Second, this was an observational cross-sectional study and therefore we cannot directly infer causality. Last, the WHO recommends four PNC visits for infants; however, the DHS data is limited to receipt of PNC in the first two days of life. As a result, future surveys and studies should also assess the coverage and determinants of all four recommended PNC visits to support interventions for continuum of care of mothers and infants.

We also note many limitations in the conceptual basis of the DHS. A primary focus on individuals and household characteristics is not illuminating of many environmental or social determinants of health which may be particularly important in PNC attendance. For example, whether communities trust government or expect a good experience is highly influential on care-seeking. As shown by a qualitative study³² in Nnewi, Nigeria, women attending antenatal care cited their primary reasons for choosing facilities as the perceived friendliness of staff, assured availability of staff, and geographic proximity, none of which are well measured by the DHS. Tax collection, redistribution, public investment, infrastructure, state-level corruption, and similar factors are all influential on individuals' trust in government and expectation of services, and all would be expected to affect PNC attendance. Similarly, it is reasonable to expect that large societal disruptions would have a large effect on PNC attendance but would not be captured well in the DHS, much as the 2014 Ebola virus diseases outbreak reduced antenatal care attendance by 50% in Liberia³³. We regard these as significant limitations to the DHS and major constraints on its ability to capture the reasons why women may choose to attend PNC.

Conclusion

National coverage on infant PNC is currently low in Nigeria with very marked heterogeneity at the state and regional levels. In addition, we identified several individual-levels factors that were associated with not attending infant PNC including not having a facility delivery of the child, low maternal education, low household health, and rural residence which can be targeted in the design of interventions to support uptake of infant PNC. Overall, our study found that mothers who are least educated, not working, poorest, and/or living in rural locations were less likely to use facilities for delivery compared to their counterpart in the urban settings and had a lower likelihood of accessing infant PNC.

Our results support the urgent need for research and implementation of interventions to promote equitable access and uptake of infant PNC in Nigeria to support achievement of global child mortality goals.

Abbreviations

PNC – Postnatal Care

WHO - World Health Organization

NDHS - Nigeria Demographic Health Survey

SDGs - Sustainable Development Goals

EAs - enumeration areas

PPS - probability proportional to size sampling

Declarations

Ethics approval and consent to participate

The study received a non-human subjects research determination from the Harvard T.H. Chan School of Public Health (Protocol # IRB21-1680)

Standards of Reporting

In addition, the conduct and reporting of the study followed the STrengthening the Reporting of OBservational studies STROBE guideline for reporting of cross-sectional studies

Consent for publication

Not applicable

Availability of data and materials

The data that support the findings of this study are available from [MEASURE DHS] but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [MEASURE DHS]

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

BEE conceived the research question. BEE and CRS designed the study. BEE acquired the data, performed statistical analysis and interpreted the results with support from CRS. BEE prepared the first draft of the article and all the authors; OAO, JBB, CRS and BEE reviewed it critically and made significant contributions to the manuscript. All authors gave their approval to submit the final manuscript.

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Figures

Figure 1

Map of infant postnatal care coverage for the 36 States and the Federal Capital Territory of Nigeria

Supplementary Files

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- [SupplementaryTable1.docx](#)