

Regional Variations in the use of Postnatal care in Nigeria: A spatial analysis

Dorothy N Ononokpono¹, Ezra Gayawan² and Sunday A. Adedini³

¹University of Uyo Nigeria, ²Federal University of Technology, Akure, Nigeria ³Obafemi Awolowo University, Ile-Ife, Nigeria

Introduction

Estimates have shown that 4 million children die within 28 days of life and approximately 28 percent of these neonatal deaths occur within the first week following delivery (NPC & ICF International, 2014). Despite the implementation of several Safe Motherhood initiatives to address high maternal and childhood mortality, Nigeria remains one of the highest contributors of maternal and under-five deaths in sub-Saharan Africa. The high maternal and child mortality ratio in the country has been linked to inadequate utilization of maternal health care services (Onah et al. 2006). Postnatal care is among the major interventions to reduce maternal and newborn deaths (Titaley et al. 2010). For both mothers and newborns, the period after delivery is very critical. The recommendation of postnatal care services to mothers and their newborn babies within 42 days after childbirth is basically to reduce neonatal deaths; hence postnatal care services enable skilled health professionals to detect postpartum problems and potential complications and provide prompt treatment (Titaley et al. 2010). Timing of postnatal check and adequate care in the postnatal period are important for the survival, wellbeing and health of the mother and their newborn (Penh, 2013).

In spite of the efforts to significantly increase postnatal care services in developing countries and its beneficial effects, the use of postnatal care has continued to remain poor. The 2008 and 2013 Nigeria Demographic and Health Surveys (NDHS) show that more than half of women in Nigeria (56% and 58%) respectively did not receive postnatal care (NPC & ICF Macro, 2009; NPC & ICF International, 2014). Thus considering the persistent poor utilization of postnatal care in a country with high levels of maternal and child mortality, it is important to understand the drivers of this poor maternal health outcome and the spatial distributions. A better understanding of the spatial effects on the use of postnatal care would be useful for effective interventions to increase the use of postnatal care and improve its coverage to women and their newborns across the various regions of Nigeria. Although some studies have documented socio-demographic factors associated with postnatal care utilization, however, they have largely ignored geographical locations in which women live and its effects; and also assumed a linear effect for all covariates. Hence, there is need to consider geographical areas with similar patterns in the use of maternal health care utilization as this would help in identifying inequalities in the use of maternal health care across regions and districts (Gayawan, 2013). In addition, spatial dependence could also help in identifying geographic hotspots or clusters of PNC utilization.

Furthermore, understanding geographical and regional variations in the use of postnatal care would help in the formulation and implementation of regional specific policies aimed at improving maternal health care. Against this backdrop, this study examines regional variations in the use of postnatal care in Nigeria while accounting for spatial effects.

Data and Methods

The study is a cross sectional study, through the analysis of secondary datasets, the 2013 Nigeria Demographic and Health Survey. The NDHS 2013 were designed to provide population and health indicators at the national and state levels. The sample frame used in the survey was lists of EAs developed from the 2006 population census. The primary sampling unit (PSU), which is referred to as the cluster, was selected from the lists of EAs. The sample for 2013 NDHS was stratified sample selected in three stages. In the first stage, 893 localities were selected, while a total of 904 EAs was selected in the second stage. The third stage involved the selection of a weighted probability sample of 40,680 households from both urban and rural areas. Details of the surveys are provided elsewhere (NPC & ICF International, 2014). In the 2013 survey, a total sample of 38,522 women was interviewed. In this study, analysis was restricted to 12053 women aged 15-49 who had last child in the two years following the survey. If a woman had more than one birth, only the last birth was considered. Also births that did not occur within the two years before the survey were excluded.

The outcome variable is postnatal care coded 1 if a woman received postnatal care from a skilled health provider (doctor, nurse/midwife) and within 42 days after delivery. The explanatory variables are: region of residence categorized as North-Central, North-East, North-West, South-East, South-West and South-South (designated by states of residence); maternal age at last birth (continuous variable measured in year) was calculated by subtracting the century month code (CMC) of the date of birth of the child from the CMC of the date of birth of the respondent. Partner's age (a continuous variable measured in year); parity categorized as: 1, 2-3, 4+; marital duration (a continuous variable measured in year); access to mass media (Newspaper, radio, television); woman's educational attainment categorized as no education, primary, secondary and higher; a woman's autonomy defined as decision making concerning health care and categorized as: wife alone, husband/others, husband and wife. Other variables include distance to hospital, skilled assistance at delivery (doctor, nurse/midwife, working status categorized as: Yes and No. The household wealth index was the DHS wealth index measured as a standardized composite variable made up of quintiles. This was determined through Principal Component Analysis (from Factor Analysis) and based on household assets (e.g. type of flooring, water supply, electricity, radio, television, refrigerator, type of vehicle). The index was constructed by assigning a factor score to each of the household assets. Each household was assigned a score for each asset, and individuals were then ranked according to the total score of the household in which they live (NPC & ICF Macro, 2009). The household wealth index of the sample was then categorized into five quintiles. Each quintile represented a relative measure of a household's socioeconomic status (Rutstein and Johnson, 2004). Type of place of residence was categorized as: urban and rural.

Method

Statistical Analysis

Both descriptive and inferential statistics were used to analyze the data at three levels. The first analysis was the description of the selected background characteristics by postnatal care. The Chi square test of association was used to examine the significance of the differences in the distribution of postnatal care by selected background characteristics. We also applied sample weights provided in the DHS data in the univariate and bivariate analyses to adjust for non-response rates and over-sampling of some areas. In the Second analysis we employed the Bayesian structured additive regression of logit model to further examine the factors that influence the use of skilled postnatal care. Finally a spatial modelling approach was adopted to quantify variation in PNC utilization across the districts (states).

Consider observations (y_i, x_i, s_i, v_i) , $i = 1, \dots, n$, where y_i is a binary response variable; y takes value 1 if the women utilized postnatal care services and 0 if otherwise,

$$y_i \sim \text{Bin}(n_i, p_i)$$

where p_i is the proportion of women that utilized the services, $x=(x_1, \dots, x_p)'$ is a vector of metrical covariates e.g. mother's age at birth, $s_i=(1, \dots, 37)$ the state (district) where woman i reside during the survey, vector $v=(v_1, \dots, v_q)'$ of categorical covariates. The logistic model with structured additive predictors is defined as

$$\log\left(\frac{p_i}{1-p_i}\right) = \sum_{j=1}^p f_j(x_{ij}) + f_{spat}(s_i) + v_i' \beta \quad (1)$$

where f_1, \dots, f_p are nonlinear (unknown) smooth functions of the metrical covariates, f_{spat} is the effect of spatial covariates, and $\beta_i = (\beta_1, \dots, \beta_L)'$ is a vector of fixed effect parameters for the categorical covariates. Bayesian structured additive regression of logit model is preferred in this study because of ease of interpretation and the possibility of computing posterior odds ratio directly from the Markov chain Monte Carlo (MCMC) output.

Fitting Bayesian models via MCMC entails treating all parameters as randomly distributed according to some prior distribution. The posterior distribution is intractable, so MCMC algorithms are used to generate samples from this prior distribution which allow estimation and inference for the parameters (Diggle, Tawn, & Moyeed, 1998).

Within a Bayesian context, all parameters and functions are considered as random variables upon which appropriate priors are assumed. Independent diffuse priors are assumed on the fixed

effects parameters. For the non-linear effects, Bayesian P-splines prior was assumed. The P-splines allows for nonparametric estimation of f as a linear combination of basis function (B-spline). For the spatial effects, we chose a Gaussian Markov random field prior, which is common in spatial statistics (Besag, York, & Mollie, 1991). This defines areas as neighbours if they share a common boundary and neighbouring areas are assumed to have similar patterns, such that the mean of area i is assumed to be an average of neighbouring areas, with variance as function of number of neighbours and spatial variance. The spatial variance was further assigned an inverse Gamma prior. For all variance components, an inverse gamma distribution with hyperparameters a and b is chosen. Standard choices of hyperparameters are $a=1$ and $b=0.005$ or $a=b=0.001$. Sensitivity to choice of hyper-priors was investigated by varying the values of a and b . The results turned out to be indistinguishable. Findings reported are based on $a=b=0.001$.

Ethical consideration

This study comprised analyses of a secondary survey data with all identifier information removed. The conduct of the survey was approved by both the Ethics Committee of the Inter City Fund (ICF International at Rockville, Maryland USA; and the National Ethics Committee in the Federal of Ministry of Health in Nigeria. Written and signed informed consent was obtained from all the participants before participation in the survey, and information was collected anonymously and confidentially.

Results

Table 1 Percentage distribution of selected characteristics of respondents by postnatal care. Nigeria, 2013 DHS

Variables	Number of women	Skilled postnatal Care	p-value
<i>State of Residence (Region)</i>	n(%)		
<i>North Central N=</i>			<0.001
FCT Abuja	77 (0.6)	76.7	
Benue	359 (2.9)	37.4	
Kogi	171 (1.4)	80.7	
Kwara	166 (1.4)	61.8	
Nasarawa	190 (1.6)	50.5	
Niger	504 (4.2)	40.5	
Plateau	200 (1.7)	34.2	
<i>North East</i>			<0.001
Adamawa	274 (2.3)	37.6	
Bauchi	558 (4.6)	32.6	
Borno	401 (3.3)	24.8	
Gombe	243 (2.0)	32.3	
Taraba	260 (2.1)	31.4	
Yobe	334 (2.7)	32.1	
<i>North West</i>			<0.001
Jigawa	663 (5.5)	15.3	

Kaduna	498 (4.1)	52.4	
Kano	1,093 (9.0)	15.8	
Katsina	698 (5.7)	12.8	
Kebbi	477 (3.9)	8.4	
Sokoto	437 (3.6)	8.7	
Zamfara	645 (5.3)	17.3	
South East			<0.001
<i>Abia</i>	119 (0.9)	38.9	
Anambra	225 (1.8)	34.6	
Ebonyi	295 (2.4)	43.2	
Enugu	210 (1.7)	43.1	
Imo	211 (1.7)	21.7	
South South			<0.001
Akwa Ibom	196 (1.6)	62.7	
Bayelsa	88 (0.7)	56.8	
Cross River	212 (1.7)	62.8	
Delta	219 (1.8)	50.9	
Edo	159 (1.3)	79.2	
Rivers	281 (2.3)	48.3	
South West			<0.001
Ekiti	67 (0.6)	58.5	
Lagos	497 (4.1)	87.3	
Ogun	297 (2.5)	74.3	
Ondo	224 (1.8)	64.0	
Osun	181 (1.5)	90.9	
Oyo	397 (3.3)	70.4	
Type of place of residence			<0.001
Rural (ref)	7,895 (65.1)	27.1	
Urban	4,232 (34.9)	58.5	
Woman's Education			<0.001
No education (ref)	5,810 (47.9)	18.5	
Primary	2,240 (18.5)	44.3	
Secondary	3,283 (27.1)	58.8	
Higher	794 (6.6)	78.2	
Access to mass media			<0.001
Newspaper			
No	10,274 (85.2)	67.5	
Yes	1,779 (14.8)	33.1	
Radio			
No	4,729 (39.1)	25.6	
Yes	7,353 (60.8)	46.1	
Television			
No	6,482 (53.7)	21.3	
Yes	5,589 (46.3)	57.5	
Parity			<0.001
1	2,685 (26.2)	45.7	
2-3	4,399 (42.8)	39.4	
4 and above (ref)	3,182 (31.0)	30.4	
Working status			<0.001
No (ref)	3,744 (31.0)	31.0	

Yes	8,327 (68.9)	41.3	
Autonomy			<0.001
Wife alone	563 (4.9)	57.6	
Husband/others	7,494 (64.8)	28.3	
Husband/wife	3,495 (30.3)	54.6	
Wealth Index			<0.001
Poor	5,594 (46.1)	17.3	
Middle	2,296 (18.9)	40.0	
High	4,238 (34.9)	64.5	
Distance to hospital			<0.001
Not a problem	8,342 (69.0)	44.5	
Problem	3,744 (30.9)	23.8	
Delivery Assisted			<0.001
No	11,311 (93.6)	34.8	
Yes	775 (6.4)	86.5	
Mother's age at birth	A continuous variable measured in year		
Partner's age	A continuous variable measured in year		
Marital duration	A continuous variable measured in year		

Table 1 presents the distribution of the study sample by background characteristics and postnatal care. The highest proportion of the sample population lived in North West (Kano, Jigawa, Katsina and Zamfara), while over two third resided in rural areas. Majority of the women did not have access to mass media (newspaper and television). However, about 60.8% indicated they listened to radio regularly. About 43% of the sample population were women of parity 2-3. Majority of the women were working (68.9%) and had lower autonomy. Over two third depended on their husbands and others for decision making concerning health care matters. The highest proportion of women were from poor households. While 69% of the sample population reported that distance was not a problem in obtaining health care, the majority of the women 93.6% were not assisted by professional health personnel (doctor, nurse/midwife) during delivery.

The results in Table 1 also reveal huge significant differences in the use of postnatal care between the different states of residence in the various regions ($p < 0.001$). The use of postnatal care was highest in North Central (FCT-Abuja 76.7%, Kogi 80.7% and Kwara 61.8%); South South (Edo 79.2%, Cross River 62.8% and Akwa Ibom 62.8%) and South West (Osun 90.9%, Lagos 87.3%, Ogun and Oyo). Meanwhile, the lowest proportion of postnatal care utilization were found in North East and almost all the states in North West particularly Sokoto, Kebbi, Zamfara and Kano. Results also show that proportion of women who used postnatal care was highest among urban women, women who had higher education and women who had access to some form of mass media particularly radio and television. Further, the lowest proportion of PNC utilization was found among high parity women. Considering working status, working mothers had the highest proportion of PNC utilization. The use of PNC was highest for women who made decisions alone (57.6%) and jointly with their husbands (54.6%). As expected, the use of PNC was highest for women from rich households, while it was lowest for women who reported that distance was a problem in assessing health care. Women who were assisted by skilled health care provider had the highest proportion of PNC utilization (86.5%).

Results of the Bayesian structured additive regression of logit model

Table 2 presents the estimated odds ratio and 95% credible intervals. Results show that compared with women who had no education, those who attained secondary and higher educational levels were significantly more likely to have accessed postnatal care services but not significant for women with primary education. As expected, women who perceived that distance to hospital is a problem were significantly less likely to have utilized postnatal services when compared with those who do not see such as a problem.

Table 2: Estimated odds ratio and 95% credible intervals for postnatal care utilization, 2013 Nigeria DHS

Variable	Posterior odds ratio	95% Confidence Interval
<i>Type of place of residence</i>		
Rural (ref)	1	
Urban	0.882	0.823, 0.943
<i>Woman's Education</i>		
No education (ref)	1	
Primary	0.985	0.882, 1.099
Secondary	1.153	1.153, 1.044
Higher	1.467	1.205, 1.777
<i>Access to mass media</i>		
Newspaper	1.195	1.098, 1.298
Radio	1.048	0.984, 1.119
Television	1.115	1.036, 1.198
<i>Parity</i>		
1	1	
2-3	0.957	0.878, 1.040
4 and above (ref)	0.895	0.785, 1.019
<i>Working status</i>		
No (ref)	1	
Yes	1.099	1.035, 1.166
<i>Autonomy</i>		
Wife alone	1	
Husband/others	0.985	0.892, 1.089
Husband/wife	1.132	1.028, 1.238
<i>Wealth Index</i>		
Poor	1	
Middle	1.116	1.028, 1.210
High	1.453	1.317, 1.607
<i>Distance to hospital</i>		
Not a problem	1	
Problem	0.861	0.811, 0.913
<i>Delivery Assisted</i>		
No	1	
Yes	2.008	1.760, 2.293

Women who were assisted during delivery were two times more likely to have utilized the services compared with those who were never assisted. Regarding access to mass media, respondents who accessed newspaper at least once a week were about 20% more likely to have utilized the services while it was about 12% more for those who had access to television at least once a week when compared with those without these access, and these are significant. However, the estimate for radio is not significant.

Compared with women who were not working at the time of the survey, those working were about 10% more likely to have utilized postnatal care services and this is significant. Women respondents who take decision in conjunction with their husbands were significantly more likely to have utilized postnatal care services when compared with those who take decisions alone, but not significant for those from households where decisions are taken by the husbands/others. Findings also reveal that, compared with women from the poorest households, those from middle and rich households were significantly more likely to have utilized the services. Results based on parity are not significant.

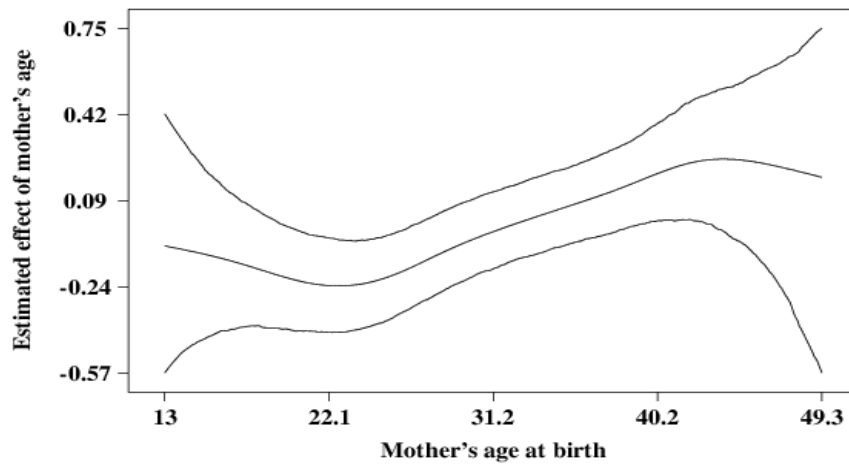
Figure 1(a-c) shows the nonlinear effects of mother's age at birth, marital duration and partner's age. It is clear that there are nonlinear relationships between the variables and utilization of postnatal services and the assumption of linear effects could have led to spurious conclusions. On mother's age at birth, findings show that from around age 13 years, utilization reduces till around age 22 years from where it rises steadily till around age 43 years before another drop. Results on marital duration show that utilization of postnatal care services was high among women who had a year experience in marriage but this reduces consistently with increase in marital duration. On partner's age, usage of postnatal services remains at same level from age 18 years to around age 36 years followed by reduction in the usage albeit, not steadily.

Results of the Spatial Effects

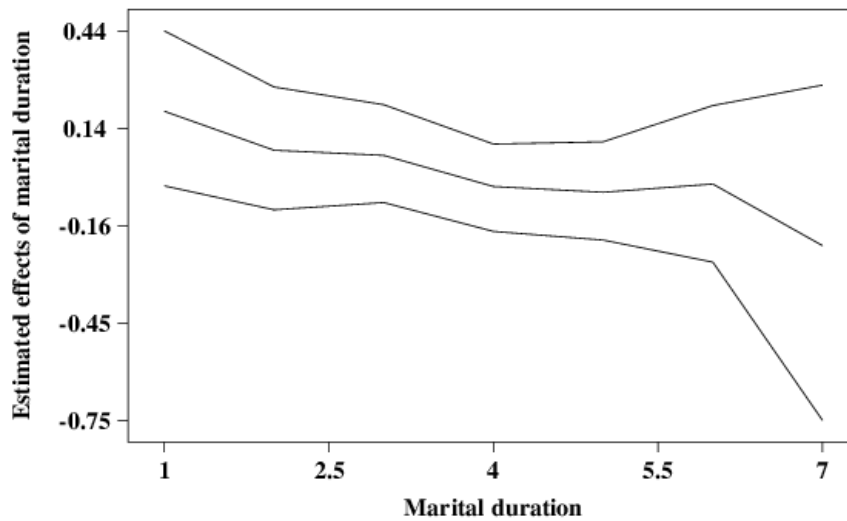
Results of the spatial analyses are presented in Figure 2 (a-d). Figure 2 (a & c) show the estimated spatial effects while Figure 2 (b & d) presents the maps of credible interval used in assessing the significant of the estimated effects. From the maps of credible intervals, states with white shading are associated with significantly higher utilization; those in black colour are associated with significantly lower utilization while estimated effects for states in gray colour are not significant. Maps in Figure 2 (a & b) show the crude distribution (without adjusting for any variable) of utilization of postnatal care services across states in Nigeria. The results show a north-south divide in utilization of the services with most states in the north eastern and north western zones of the country having significantly lower likelihood of utilizing the services but higher for those in the south west and some states in the south east, south south and north central

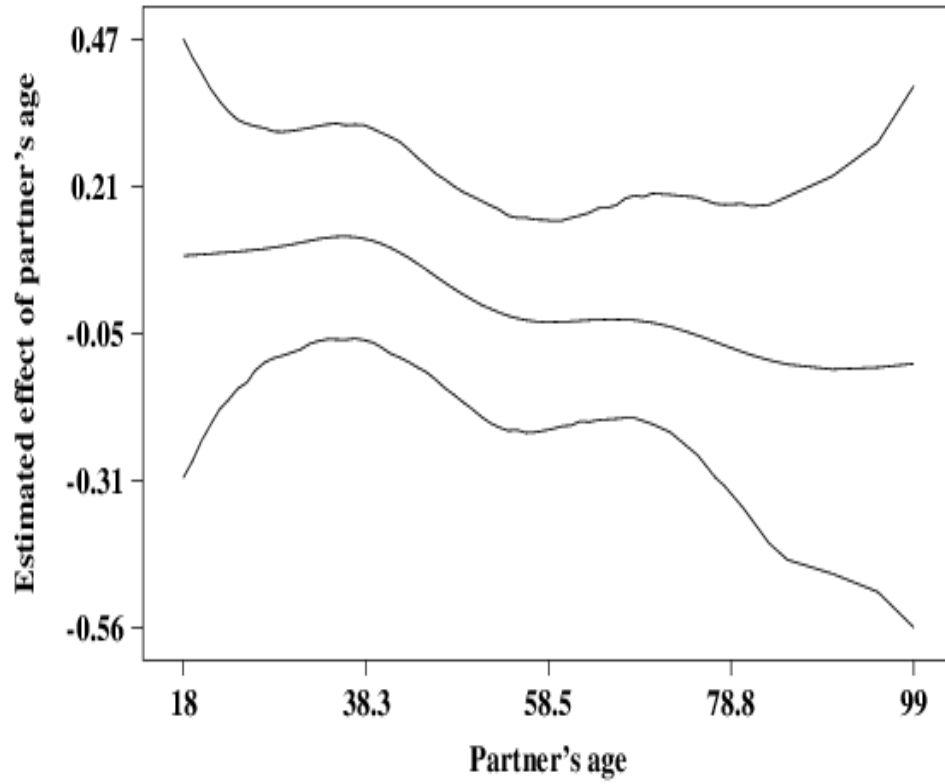
zones. The pattern however changed considerably when the observed variables were accounted for in the analyses as evident by findings presented in Figure 2 (c & d). The residual spatial variations show significantly higher utilization in Yobe, Bauchi, Niger, FCT, Nasarawa, Kogi, Lagos, Ogun, Oyo, Osun, Ondo, Edo, Akwa Ibom, and Cross River but significantly lower in Sokoto, Kebbi, Zamfara, Katsina, Kano, Jigawa, Rivers, Imo, Abia, Enugu, Anambra and Adamawa states.

(a)



(b)

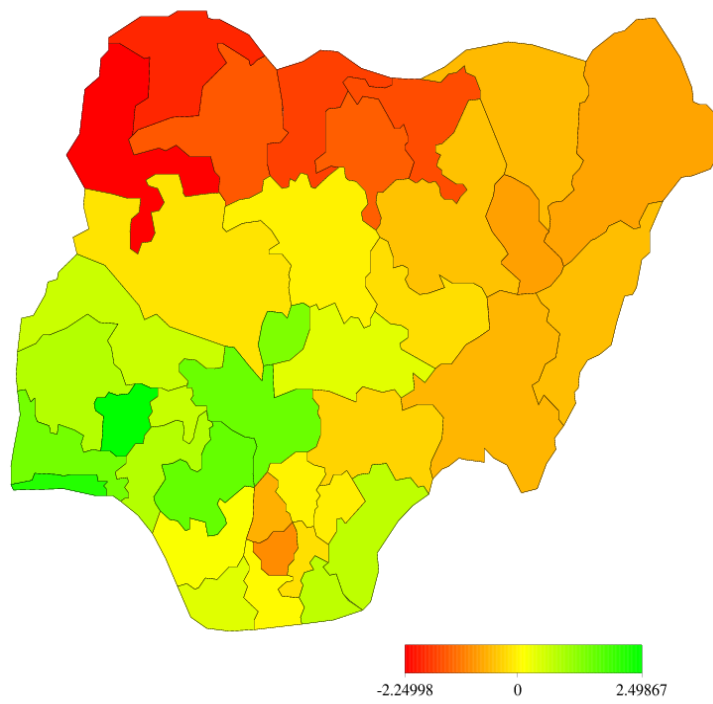




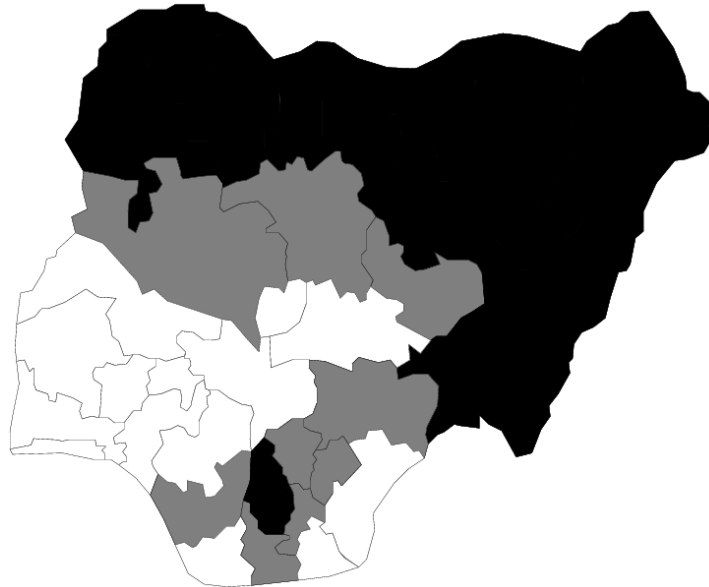
(c)

Figure 1: Nonlinear effects of (a) mother's age at birth; (b) marital duration and (c) partner's age.

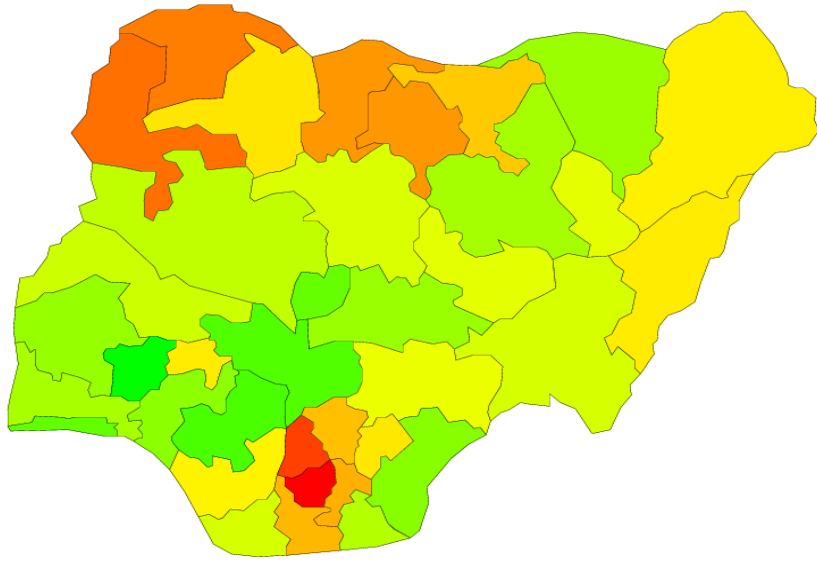
(a)



b)



(c)



(d)

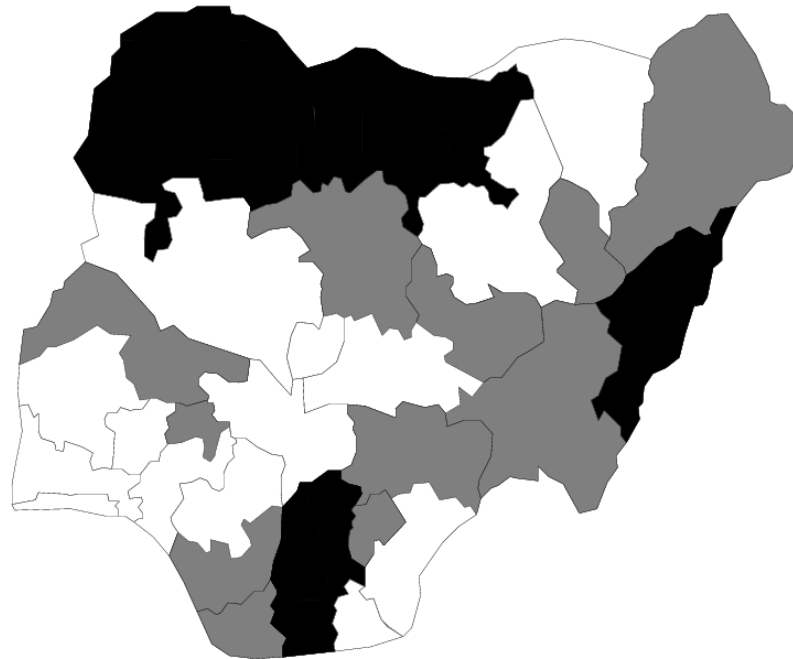


Figure 2: maps of Nigeria showing the spatial effects of postnatal care utilization for (a) crude data (without adjusting for any covariate) and (b) its map of 95% credible interval; (c) after adjusting for observed covariates and (d) its map of 95% credible interval.

Discussion and Conclusion

The findings of the study suggest that understanding geographical variations and factors associated with the use of maternal health care is important in designing effective intervention programmes aimed at addressing the poor maternal health indicators in Nigeria particularly postnatal care. The results revealed huge variations in the use of postnatal care across regions and postnatal care was associated with individual and household variables as well as community variables. Specifically the spatial effects revealed that the utilization of postnatal care was highest in some of the states in North East and North West including Sokoto, Kebbi, Zamfara, Katsina, and Kano. Without controlling for spatial effects in this study, the result of the bivariate analysis and fixed effects would have been misleading as one would have concluded that the use of postnatal care was lowest in all the states in the North East and North West. In summary, this study clearly shows differentials in postnatal care utilization, hence the need for policy makers to pay attention to these variations and design specific programs that would help in improving the use of maternal health care services particularly postnatal care in disadvantaged states.

Notably, the observed spatial effects do not have direct causal effects as noted in a previous study (Gayawan, 2013). How the plausible explanation could be that other socio-economic and other unobserved factors, for instance location of health centres and availability of maternal health care service may have influenced the utilization of PNC. The findings of the study also show that socio-economic variables were significantly associated with PNC. The finding that education, working status and household wealth index were significantly and positively associated with postnatal care are consistent with other studies (Babalola and Fatusi, 2009; Ononokpono et al 2014) and may reflect higher socio-economic status which is associated with better health outcomes (Antai, 2009). This points to the need to empower women educationally and economically.

Further the result of our study revealed a none-linear association between PNC utilization and other demographic variables such as mother's age at last birth, partner's age, and marital duration. This finding is an indication that the relationship between these demographic variables and the use of maternal health care services are not always linear. Thus the assumption of linear effects has the potential to mislead policy makers. Finally, the findings of this study suggest the importance of socio-economic and demographic factors as well as contextual effects in explaining the variations in postnatal care utilization in Nigeria. Thus developing region – specific health policy capable of addressing the needs of the different populations with respect to increasing postnatal care utilization within the country should be considered.

Limitations and Strength of the Study

This study, however, had some limitations that are noteworthy. The cross-sectional design of the study did not permit determining the temporal relations of the individual and community variables to the dependent variable and hence limited the potential causal inferences that could be drawn. Since the events took place two years before the survey, the study may have involved some recall bias, given that the events took place five years before the survey, and those participants who used health care services or had better outcomes may have had different recall than those who did not.

These limitations notwithstanding, the findings represent a further step toward an understanding of spatial effects on the use of PNC in Nigeria.

Acknowledgements.

The authors wish to thank Measure DHS and ICF International for permission to use the 2013 Nigeria DHS Data.

References

- Antai, D. (2009). Inequitable childhood immunization uptake in Nigeria: a multilevel analysis of individual and contextual determinants. *BMC Infectious Diseases* 9, 181. doi: 10.1186/1471-2334-9-181
- Babalola, S., & Fatusi, A. (2009). Determinants of use of maternal health services in Nigeria - looking beyond individual and household factors. *BMC Pregnancy and Childbirth*, 9, 43. doi:10.1186/1471-2393-9-43
- Besag, J., York, Y., & Mollie, A. (1991). Bayesian image restoration with two applications in spatial statistics (with discussion). *Annals of the Institute of Statistical Mathematics*, 43(1), 1-59
- Diggle, P. J., Tawn, J. A., & Moyeed, R. A. (1998). Model-based geostatistics (with discussion). *Applied Statistics*, 47, 299-350
- Gayawan, E. (2013). A poisson regression model to examine spatial patterns in antenatal care utilization in Nigeria. *Population, Space and Place*, 20(5). doi:10.1002/psp.1775.
- National Population Commission (NPC) [Nigeria] and ICF International. 2014. *Nigeria Demographic and Health Survey 2013*. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International
- National Population Commission (NPC) [Nigeria] & ICF Macro. (2009). *Nigeria Demographic and Health Survey 2008*. Abuja, Nigeria: National Population Commission and ICF Macro.
- Onah, H. E., Ikeako, L. C., & Iloabachine, G. C. (2006.). Factors associated with the use of maternity service in Enugu south eastern Nigeria. *Social Science and Medicine*, 63, 1870-1878.
- Ononokpono, D.N., Odimegwu, C.O., Imasiku, E.N.S & Adedini, S.A. (2014). Does It Really Matter Where Women Live? A Multilevel Analysis of the Determinants of Postnatal Care in Nigeria. *Maternal and Child Health Journal*, volume 18(4):950-959. DOI 10.1007/s10995-013-1323-9
- Penh, P. (2013). Early postnatal Care and its determinants in Cambodia: Further analysis of Cambodia Demographic and Health Survey. National Institute of Statistics, Ministry of Planning, Cambodia.
- Rutstein, S. O., & Johnson, K. (2004). The DHS Wealth Index. *The DHS Wealth Index DHS comparative report..* Calverton, Maryland USA United States Agency for International Development.