CONTEXTUAL INFLUENCES ON THE USE OF ANTENATAL CARE IN NIGERIA.

Extended abstract

Globally, more than 500,000 women die annually as a result of complications during pregnancy.. The importance of antenatal care (ANC) in identifying complications during pregnancy and thus preventing maternal mortality has received significant recognition worldwide. More so, the number and timing of ANC are important factors to prevent an adverse pregnancy outcome and can make significant contributions to the reduction of maternal morbidity and mortality (Abedin et al, 2008). Antenatal care is most effective if the visits are started at early stage of pregnancy and at regular intervals. According to the Focused Antenatal Care (FANC) approach in Nigeria, it is schedule that the first visit should occur by the end of 16 weeks of pregnancy, the second visit should be between 24 and 28 weeks, and the third and fourth visit should take place between 32 and 36 weeks respectively (NPC & ICF Macro, 2009).

Early dictation of pregnancy complications can lead to prompt treatment and referrals. This is very crucial considering the fact that Nigeria is a large country and physical barriers are a challenge to accessing healthcare (NPC & ICF Macro, 2009). Despite the benefits of this intervention, most women in Nigeria do not receive adequate antenatal care during pregnancy. In Bauchi state Nigeria, for instance, women on the average bear about eight children throughout their lifetime, yet only 45% receive antenatal care (www.jsi.com). Similarly, among eighty-one women who delivered within a one year period in Edo state, Nigeria, only 9.9% received antenatal care (Osubor et al., 2006). The 2008 Nigeria Demographic and Health Survey report indicate that about 55% of women had fewer than four antenatal care visits recommended by the World Health Organization. Worst still only 16% of women had their first ANC visit during the first trimester of pregnancy. Considering the need to build a responsive health care system and the Millennium Development Goal to reduce maternal mortality by three quarters by 2015, it is necessary to understand the contextual factors influencing the decisions to seek antenatal care.

Several studies have identified education, occupation, parity, maternal age, women's autonomy, cost and distance to health facility as important predictors of antenatal care (Titaley et al., 2010; Dhakal et al., 2007; Furuta and Salway, 2006). Previous studies, however, have approached this issue by examining individual and household predictors and have largely ignored community contextual influences on antenatal care. Understanding contextual influences in the study of maternal health care is important because individuals are nested within households and households are embedded in communities hence individual decisions can also be influenced by the characteristics of the communities in which they live (Mackian, 2003). More importantly ecological perspectives suggest multiple levels of influence of physical and social environmental conditions on health behaviour (Stokols, 1996). This study builds on previous studies to examine the influence of community contextual factors on a woman's decisions to seek antenatal care in Nigeria.

Methods

The study is a cross sectional household survey- the 2008 Nigerian Demographic and Health Survey (NDHS). The 2008 NDHS provided information on population and health indicators at the national, zonal and state levels. The primary sampling unit (PSU), which is referred to as the cluster was selected from the lists of Enumeration Areas (EAs). Sample for the survey was

selected using a stratified two-stage cluster design, made up of 888 clusters (NPC and ICF, 2009). A weighted probability sample of 36,800 households was selected in the survey. In all, a total sample of 33,385 women aged 15-49 years and 15,486 men aged 15-59 were interviewed. For the purpose of this study, a sample of 17635 women aged 15-49 years who reported to have their most recent delivery occurring in the five years preceding the survey was selected. In the selection of the sample, only the last birth was considered and all previous births other than the last were excluded using appropriate Stata command. The consideration for the last delivery was occasioned by the fact that information on maternal health care for the last birth tends to be more accurate than that given for previous birth (Kistiana, 2009)

Variable definitions

The key dependent variable is antenatal care which is defined as having skilled antenatal care visits during pregnancy. The indicators of antenatal care visits examined in this study are number of ANC visits and timing of first antenatal care visit. Number of antenatal care visits is categorised into three groups consisting of those women who attended no skilled ANC visit, those who attended between 1 and 3 skilled visits and those attending 4 or more. Timing of ANC visit is measured as number of months pregnant at the time of first ANC visit. This was grouped and categorised as "first visit ≤4 months of pregnancy" and "5 or more months of pregnancy". We included other independent variables that can influence the number of ANC visits a woman may have during pregnancy and timing of visits.

Individual variables

These include age, education, ethnic origin, religion, parity, birth order and exposure to family planning messages. Age is defined as a woman's age at the birth of the last child and classified as 15-24 25-34 35-49 years. Education is the highest level of educational attainment and categorised as no education, primary, secondary and higher. Religion is categorised as Muslim, Catholic, Other Christian and Traditional religion/others. Parity is defined as the number of children ever born and grouped as 1, 2-4, 5+. Birth order is grouped as 1, 2-3. 4+. Exposure to family planning messages is defined as women's exposure to family planning messages through the media (radio and television). This was grouped as exposed and not exposed.

Household variables

The household variables include household economic status and household size. The DHS wealth index is a proxy for measuring economic status and was constructed from data on household assets. The principal component analysis (PCA) was used to assign a weight (factor score) to each of these assets and the resulting sum of the scores was standardized with a mean of zero and a standard deviation of one (Rutstein & Johnson, 2004). The household economic status was categorised as poorest, poor, middle, richer and richest. Household size is considered in this study because of its association with household economic resources which can enable or deter women from seeking health care. This variable is defined based on the number of persons living in a household. Households with members between 1 and 4 are classified as "small" and those having 5 or more members are "large"

Community contextual variables

Community refers to the primary sampling unit (PSU) or clusters which are administratively defined areas and are important in research that involves policies (Antia, 2009). In addition PSUs are fairly homogenous with respect to population socio-demographic characteristics and economic status; and is made up of one or more Enumeration Areas (EAs). About 888 clusters were selected in the 2008 NDHS and each cluster consists of an average of 41 households (NPC & ICF Macro, 2009). In this study, three community variables were assessed and these include ethnic diversity, community hospital delivery and community women's education. Other contextual variables are type of place of residence and region of residence. Ethnic diversity was assessed because the presence of diverse ethnic groups in a community may enhance diverse health practices of other people which may influence ANC attendance. Community hospital delivery was assessed because this could indicate the availability of maternal health services in the community (Stephenson et al., 2006) which may increase the chances that pregnant women will attend antenatal care frequently and on time. Community women's education was included because higher levels of maternal education are associated with better awareness and use of maternal health care services Ethnic diversity is defined as the proportion of women from different ethnic groups in the community (PSU) and is divided into three quantiles low, medium and high. Community hospital delivery is the proportion of women that delivered in a health facility in the PSU and categorised as low, medium and high. Community women's education is the proportion of women with secondary and higher education in the primary sampling unit. The measure was divided into three quantiles and categorised as low, medium and high. Region of residence represent political and administrative boundaries categorised as: North central, North east, North west, South east, South south, South west. Type of place of residence classified as urban and rural.

Statistical analysis

The distribution of respondents by key variables was assessed and expressed as percentages. At the bivariate level, frequencies and cross-tabulations were used to identify the distributions of the outcome variables by selected background characteristics. The chi square test of association was used to test the statistical significance of these bivariate distributions. Sample weights provided in the DHS data were applied for the univariate and bivariate analyses in order to adjust for non-response and over sampling of some areas. For all analyses, Stata 11.1 software package was used. Multilevel logistic regression was utilized to assess the impact of measured individual and community level factors. Multilevel analysis was considered appropriate in order to account for the hierarchical nature of the DHS data (Antai, 2009) and to be able to estimate community level effects on the outcome variable. A two-level multilevel logistic regression model was applied in the study and this consists of two sub models at level 1 and level 2. This implies that individuals (level 1) were nested within communities (level 2). The level 1 model represents the relationships among the individual level variables[1], while the level 2 model examines the influence of community level factors.

[1] Both individual and household characteristics are considered as individual level variables in the study. The reason for this is because, the analysis is based on two levels and the average number

A two-level multilevel model for a dichotomous outcome uses a binomial sampling and a logit link (Vu, 2005). In level 1 model, the outcome variable Y_{ij} for individual i living in community j is written as follows:

Probability ($Y_{ij} = 1|B$) = Φ_{ij}
Level 1 variance = [Φ_{ij} (1 - Φ_{ij}]*
Predicted log odds η_{ij} = log [Φ_{ij} / (1- Φ_{ij})]

$$\eta_{ij} = \beta_{0j} + \sum_{q=1} \beta_{qj} X_{qij} \qquad (1)$$

Where

Φ_{ij} is the probability that the ith individual in the jth community take value "1" ("1" indicates that the event will occur)
β_{0j} is the level 1 intercept

β_{qj} is level 1 coefficients

X_{qij} is level 1 predictor q for ith individual within jth community

In level 2 model, each of the level 1 coefficients, β_{qj} defined in the level 1 model becomes an outcome (Vu, 2005) and can be expressed as follows:

$$\beta_{qj} = \gamma_{q0} + \gamma_{q1}W_{1j} + \gamma_{q2}W_{2j} + \ldots\ldots\ldots\ldots + \gamma_{q}s_{q}Ws_{qj} + u_{qj}$$

$$= \gamma_{q0} + \sum_{s=1}^{S_q} \gamma_{q}sW_{sj} + u_{qj} \qquad (2)$$

Where

γ_{qs} (q = 0,1,.....S_q) are level 2 coefficients

Wsj are level 2 predictors and u_{qj} is level 2 random effects

All the level 2 random effects are assumed to have normal distribution with mean of 0 (zero) and variance of τ_{qq} (Vu, 2005). A comparison of the variance component (τ_{qq}) of the intercept (β_0)

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of women in a household as contained in the dataset is small (1.7) and thus the household cannot be considered as a level of analysis in this case.

with its standard error gives an indication whether there are variations among communities in terms of antenatal and delivery care utilization.

Overall, four models containing variables of interest were fitted for each of the maternal health care indicators or outcome variables. The first model which is usually called the "empty" or "null model" was fitted without explanatory variables. In other words, it contained no covariates, but decomposes the total variance into individual and community components. The empty model was used to determine whether the overall difference between communities and individuals in terms of antenatal and delivery care was significant. The second model referred to as the "individual model" included individual characteristics. This is to allow the assessment of the association between the outcome variable and individual characteristics. The model containing the individual level variables was used to determine whether the variation across communities could be explained by the characteristics of the individuals residing within that community or not.

A third model was also fitted and this contains only the community characteristics to allow the assessment of the impact of the community variables on the outcome variable.

Lastly a fourth model was generated which is called the "final model". This included explanatory variables at both the individual and community levels. The final model was used to test for the independent effect of community contextual variables above and over the individual variables.

In the multilevel models, fixed effects refer to the individual and community covariates and were expressed as odds ratio (OR) and 95% confidence interval. The random effects are the measures of variation in maternal health care (antenatal and delivery care) across communities. The ratio of the variance at the community level to the total variance is referred to as the intra-class correlation coefficient. The precision was measured by the standard error (SE) of the independent variables (Antai, 2009). The results of random effects (which are the measures of variation) are expressed as Variance Partition Coefficient (VPC) (which in this study is equal to intra-class correlation (ICC)), and proportional change in variance (PCV). As a result of the dichotomous nature of the outcome variables in the study, the VPC was calculated based on the linear threshold model method which converts the individual level variance from the probability scale to the logistic scale, on which the community level variance is expressed (Merlo et al., 2006). In other words, by using the linear threshold model, the unobserved individual outcome variable follows a logistic distribution with individual level variance σ^2_e equal to $\pi^2/3$ (equal to 3.29). In this case, the VPC corresponds to the intra-class correlation coefficient (ICC), which is a measure of general clustering of the individual outcome of interest in the communities.
The intraclass correlation is calculated as:

$$\rho = (\sigma^2_\mu / (\sigma^2_\mu + \pi^2/3)) \qquad (11)$$

Where

ρ is the intraclass correlation (ICC). σ^2_μ is the variance at the community level. $\pi^2/3 = 3.29$ and represents the fixed individual variance (Snijders & Bosker, 1999).

Community differences in antenatal and delivery care may be attributable to contextual influences or differences in individual composition of communities (including unobserved individual

characteristics) (Merlo et al, 2004). In view of this, while adjusting for the individual characteristics in the multilevel models, some part of the compositional differences were taken into consideration to explain some of the community differences observed in the empty model. Thus the equation for the proportional change in community variance is:

$PCV_1 = (V_{N-1} - V_{N-2})/ V_{N-1}$ (12)

Where
V_{N-1} is the community variance in the empty model and V_{N-2} is the community variance in the models including individual characteristics or community characteristics.

Statistical Tests

The maximum likelihood was evaluated by integrating out the random effects using the adaptive Gaussian quadrature (AGQ) (Gutierrez, 2007) available in Stata (version 11.1). While the likelihood ratio (LR) statistics was used to test the null hypothesis that the community level variance is equal to zero. Regression diagnostics AIC (Akaike information criterion) and the BIC (Bayesian information criterion) were used to determine the goodness of fit of the model. The AIC is appropriate for comparing non-nested models such as those estimates used in the analysis and is calculated as -2 (log-likelihood of fitted model) +2p, where p is number of parameters in the model (Boco, 2010). The AIC and BIC values for each model are compared and the model with the lowest value is considered to be a better explanatory model (Uthman & Kongnyuy, 2008).

Results

Multilevel analysis

Preliminary results in Table 1 (Model 1) showed that there is variation in the likelihood of having four or more antenatal care visits across communities and this variation was significant (τ = 11.071, p = 0.001). As shown by the variance partition coefficient, the intra-community correlation coefficient was estimated at 77%, which is variance that could be attributed to the community level. Model 2 showed the results of the effects of the individual level variables. Maternal age at last delivery was significantly associated with antenatal care visits with middle aged women (25-34) more likely to attend four or more antenatal care visits compared to those of younger age (15-24). Consistent with some earlier studies, educational level of the woman, ethnic origin, occupation, women's autonomy and household wealth index were significantly associated with antenatal care visits.

Women with primary and secondary/higher education had significant odds of having four or more antenatal care visits that were 2.9 times and 5.8 times higher respectively compared to those with no education. Relative to Hausa, women from Igbo, Yoruba and Northern/Southern minority ethnic groups were 9.9 times, 32.9 times and 4.3 times respectively more likely to found to make four or more antenatal care visits. Women in formal employment and skilled manual workers were almost twice more likely to have four or more antenatal care visits compared to those with no employment. In line with expectation, the odds of having four or more antenatal care visits was

higher for women from richest, richer and middle households relative to women from poorest households. In comparison to the empty model, the variation in having four or more antenatal care visits was significant across communities ($\tau = 2.969$; $p<0.001$). The intra-community correlation was 47.4% indicating that the clustering of the outcome variable (antenatal care visits) across communities was as a result of the composition of the communities by individual level characteristics.

The results of the effects of community variables were presented in model 3. As indicated, all the community variables were positively and significantly associated with antenatal care visits. In line with expectation, the likelihood of having four or more antenatal care visits was higher among women who resided in South West and South East relative to those who resided in North Central region. Meanwhile living in North east and North West was associated with lower odds. Results further showed that women who lived in communities with high proportion of women with secondary and higher education, high proportion of women who delivered in a hospital, and high proportion of women who were exposed to mass media were 3.4 times, 5.8 times and 3.9 times respectively more likely to attend antenatal care at least four times relative to those living in disadvantaged communities. Community poverty was significantly associated with number of antenatal care visits. Living in communities with high proportion of women who were from poor households was associated with lower odds of attending four or more antenatal care visits. Compared to model 2 the variation in antenatal care visits across communities remained significant ($\tau = 2.550$, $p = 0.001$). The intra-community correlation was 43.6 %, indicating that the clustering of antenatal care visits between communities was as a result of the composition of the communities by community characteristics.

Model 4 was the final model for antenatal care visits and contained both the individual/household and community variables. Results showed that the inclusion of community variables had independent effects on antenatal care visits as well as moderating effects on the association between individual/household factors and antenatal care attendance. For instance with the introduction of community variables, the significance of maternal age at last birth as observed in model 2 disappeared. However, the effects of education, occupation, ethnic origin, women's autonomy and household wealth index remained significant but with slight reduction in odds for education, ethnic origin and household wealth index variable categories. The odds of having four or more antenatal care visits was 5.8 times higher for women with secondary/higher education, 2.9 times for those who belong to Igbo, 4.5 times for women of Yoruba ethnic origin and 2.5 times for those from Northern/Southern minority ethnic groups. Relative to women from poorest wealth quintiles those from the richest wealth quintiles were 15.5 times more likely to have four or more antenatal care visits. Women in formal employment, and those who made joint decision with husband on health care were 1.6 times and 2 times respectively more likely to attend antenatal care. Whereas the likelihood of having four or more antenatal care visits was 67% lower for women from North West and 39% lower for those from South south; the odds was higher for women from South East and South West (Odds ratio = 4.096; $p<0.001$) compared to North Central. The difference however was not statistically significant for South east.

Further, the results showed that living in communities with high proportion of women who had hospital delivery, and high proportion of women exposed to mass media was associated with higher likelihood of having four or more antenatal care visits. However living in communities with high proportion of women from poor households decreased the odds by 64%. The association between community women's education and number of antenatal care visits was not significant

Comparatively the variance at the community level in model 4 remained significant ($\tau = 2.149$; $p<0.001$). The intra-community correlation decreased to 39.5 percent indicating that the inclusion of community variables was important for obtaining a better explanatory model. The clustering of the likelihood of having four or more antenatal care visits at the community level is as a result of the composition of the communities by community characteristics. Further, it also indicates that part of the clustering in antenatal care visits between communities was due to the composition of communities by individual characteristics.

Table 1 Multilevel logistic regression odds ratio of the effects of individual and community factors on Antenatal care visits, Nigeria 2008 DHS

Variables	*Model 1 Empty model*	*Model 2 Individual variables*	*Model 3 Community variables*	*Model 4 Individual & community*
		Odds Ratio	Odds Ratio	Odds Ratio
Fixed effects				
Individual characteristics				
Maternal age at last birth				
15-24		1.000		1.000
25-34		1.216*		1.179
35-49		0 .978	-	0.923
Educational attainment				
No education		1.000		1.000
Primary		2.923***	-	2.572***
Secondary/Higher		5.881***		5.153***
Ethnic Origin				
Hausa		1.000	-	1.000
Igbo		9.606***		2.965**
Yoruba		32.992***		4.522***
North/South minority		4.300***		2.405***
Occupation				
Unemployed		1.000	-	1.000
Formal employment		1.579***		1.567***
Agric employment		0 .950		0.940
Skilled manual workers		1.639**		1.764***
Women's autonomy				
Wife alone		1.000	-	1.000
Wife/Husband		1.873**		2.043***
Husband alone/Others		1.169		1.409*
Household wealth index				
Poorest		1.000		1.000
Poorer		2.250***	-	1.915***
Middle		5.103***		3.123***
Richer		11.375***		4.899***
Richest		46.122***		15.547***
Region of residence				
North Central			1.000	1.000
North East			0.598**	1.229
North West			0.161***	0.331***
South East			1.933**	1.158
South South			0.792	0.614*
South West			7.808***	4.096***
Community women's education			1.000	1.000
Low			2.994***	1.316
Medium			3.435***	0.863

High				
Community hospital delivery[b]				
Low				
Medium			1.000	1.000
High			5.057***	4.038***
			5.817***	4.232***
Community poverty				
Low			1.000	1.000
Medium			0.351***	0.844
High			0.091***	0.361***
Community mass media exposure				
Low			1.000	1.000
Medium			2.618***	2.332***
High			3.937***	3.159***
Random effects parameters	***Empty***	***Individual***	***Community***	***Individual/ Community***
Community level				
Variance (SE)	11.071*** (3.903)	2.969*** (1.024)	2.550*** (0.719)	2.149*** (0.662)
VPC=ICC (%)	77	47.4	43.6	39.5
(PCV) (%)	Reference	73.2	76.9	80.6
Log-likelihood	**-8155.0025**	**-6806.1056**	**-7591.7326**	**-6636.2953**
Model fit statistics				
AIC	16316.0	13650.2	15215.5	13336.6
BIC	16339.2	13795.6	15339.0	13581.4

The empty model contains no variables but partitions the variance into two component parts
SE = Standard error, VPC= Variance Partition Coefficient, PCV = Proportional change in variance, AIC=Akaike information criterion, BIC = Bayesian information criterion
Significance level ***p<0.001 **p<0.01 *p<0.5

Conclusion

Findings indicate that community factors have significant influence on women's decisions to use maternal health care. This suggests that interventions to encourage the use of antenatal care should not only be implemented at the individual level but tailored to community context. Community interventions conceived without consideration for community context in which women live will have limited impact, unless they are informed by data that appreciates the important connection between community contextual factors and the use of maternal health care. In addition community interventions should aim at empowering women economically, increasing women's education and hospital delivery in disadvantaged communities.