

Maternal health care in Nigeria: Do community factors moderate the effects of individual-level Education and Ethnic origin?

Dorothy N Ononokpono

Department of Sociology and Anthropology University of Uyo
P.O.Box 1017, Uyo Nigeria
doraono@gmail.com

Abstract

Maternal mortality ratio in Nigeria is still high despite the initiation of the safe motherhood initiative. The poor maternal health situation has been attributed to inadequate use of maternal health care services. This study examines whether community factors moderated the association between individual factors and the use of skilled ANC. Data on 17560 women aged 15-49 years drawn from 2008 Nigeria Demographic and Health Survey were used. Multilevel logistic regression models were used for analysis. Results reveal variations in the use of skilled ANC across the Northern and Southern regions. Residence in communities with a high proportion of women that delivered in a health facility increased the odds of skilled ANC utilization. Community education and poverty moderated the association between individual factors and the utilization of skilled ANC. To improve the use of ANC and increase the pace towards achieving the sustainable Development Goal-improved maternal health in the post 2015 era, increasing health facility delivery, women's education and targeting poverty alleviation programs in disadvantaged communities should be taken into consideration.

Keywords: Antenatal care, community, maternal health care, multilevel models, Nigeria

Résumé

Ratio de mortalité maternelle au Nigéria est encore élevé malgré l'ouverture de l'initiative pour une maternité sans risque. La mauvaise santé maternelle situation a été attribuée à l'insuffisance des services de soins de santé maternelle. Cette étude examine si facteurs communautaires a modéré l'association entre facteurs individuels et l'utilisation de l'ANC qualifiés. Données sur 17560 femmes âgées de 15 à 49 ans tirées de 2008 le Nigeria enquête sur la démographie et la santé ont été utilisés. Multiniveau modèles de régression logistique ont été utilisées pour l'analyse. Les résultats révèlent des variations dans l'utilisation de l'ANC qualifiés partout dans les régions du Nord et du Sud. Résidence dans des communautés avec une forte proportion de femmes que livré dans un établissement de santé a accru les chances de l'ANC qualifiés l'utilisation. L'éducation communautaire et la pauvreté modérée l'association entre facteurs individuels et l'utilisation de l'ANC qualifiés. Pour améliorer l'utilisation de l'ANC et de l'augmentation du rythme vers la réalisation de l'objectif de développement durable et l'amélioration de la santé maternelle dans le poste 2015 ère, à accroître la santé installation de livraison, l'éducation des femmes et le ciblage des programmes de lutte contre la pauvreté dans les communautés défavorisées devraient être prises en considération.

Mots clés : soins prénatals, de la communauté, les soins de santé maternelle, modèles à plusieurs niveaux, le Nigéria

Introduction

Globally, 210 maternal deaths per 100,000 live births occur due to pregnancy related complications (WHO, 2014). Although, maternal mortality ratio has declined in developed countries, the rate remains high in developing countries. Sub-Saharan Africa accounts for 62 percent of world's maternal deaths (WHO 2014). With as estimated maternal mortality

ratio of 560 per 100,000 live births (World Bank, 2014), Nigeria ranks second in the list of countries with the highest rate of maternal mortality in the world. The importance of the use of maternal health care in reducing maternal mortality is well recognized and some researchers have argued that health care services are important in determining the overall

maternal mortality levels in developing countries (Ikamari 2004; Onah, 2006).

Appropriate maternal health care is important in the management of complications of pregnancy (Magadi et al. 2003). Antenatal care service is one of the major interventions recommended for the reduction of maternal and newborn deaths (Titaley et al. 2010). It also provides some preventive interventions for pregnant women. These include tetanus immunization, nutrition education, and counselling regarding their plans for delivery and postpartum family planning (Ikamari, 2004). Antenatal care ensures optimal outcome for both mother and baby, and is important in monitoring pregnancy and reduction of morbidity and mortality (NPC & ICF Macro, 2009). World Health Organization (WHO) recommended antenatal care from a skilled health worker (example midwife, doctor or nurse). Furthermore, antenatal care provides opportunity for pregnant women to identify complications associated with pregnancy and benefit from other interventions including counselling on healthy lifestyles and management of complications (Kistiana, 2009).

Despite the benefits of antenatal care, the Nigeria Demographic and Health Survey (NDHS) 2008 report indicated that less than two third (58 percent) of women in Nigeria received skilled antenatal care during pregnancy (NPC & ICF Macro, 2009).

The poor maternal health situation in Sub-Saharan African countries and Nigeria in particular is worrisome; and attempts have been made by researchers to understand the determinants of this phenomenon. While most studies on maternal health care have focused on the influence of individual-level determinants, the influence of community-level factors has received less attention. As a result of the emphasis on the influence of individual-level factors, efforts to improve the use of maternal health care services have concentrated on addressing individual-level characteristics such as maternal education, ethnic origin and household wealth status which have been identified as important determinants of maternal health care. Studies have shown that knowledge about the individual-level factors is not sufficient to address the problem of poor maternal health care behaviour (Mackian, 2003; Rahman, 2000). Hence, it is important to look beyond the individual-level characteristics. The rationale for considering the characteristics of the community in which people live has been well recognized (Robert & House, 2000; Blalock, 1984). For instance, individuals live in communities and their health care behaviour could be influenced by the characteristics of other members of the communities in which they reside.

Although some studies have examined the independent effects of community factors on the use

of maternal health care services (Babalola and Fatusi, 2009; Stephenson et al 2006), there is a dearth of studies on the moderating effects of community factors on the association between individual-level factors and maternal health outcomes. Extant studies in Nigeria have shown that maternal education and ethnic origin are strong determinants of maternal health care behaviour (Doctor 2011; Wall, 1998). Furthermore, other studies have established that many contextual or aggregate variables such as community education and poverty which have been hypothesized to influence health vary over geographic and social units (Boco, 2010; Vu, 2005).

Most communities in Sub-Saharan African countries have different characteristics and vary in terms of socio-economic development and maternal health outcomes. Nigeria is ethnically and socially diverse, and there are variations in health outcomes across the different communities in the country. Hence it is important to examine whether the influence of selected individual-level factors (education and ethnic origin) on maternal health care could be mitigated by community factors. This will help to identify individual and community factors that could be targeted for interventions to improve maternal health.

Literature Review and Theoretical framework

A number of factors have been associated with the use of maternal health care. Some studies in Asia found that women's autonomy was strongly associated with antenatal care utilization (Bloom et al., 2001; Shaikh & Hatcher 2004). The authors noted that men control all aspects of resources and decide when and where women should seek health care. In addition, Matthews and Gubhaju (2004) observed that women who hold strong views on the right to refuse sex with their partner were more likely to use antenatal care; married women were more likely to use antenatal care if they make more decisions in the household, if they were educated, if they have educated partner and if they regularly listened to the radio or watch television.

Cultural beliefs and practices were important determinants of maternal health-seeking behaviour (Shaikh et al. 2008; Griffiths & Stephenson, 2001). This indicates that the use of maternal health care is not only related to the individual's choice, but also to a large extent depends on the socio-cultural arrangements of communities. Socio-cultural factors impinge negatively on women's access to health care. In Islamic countries for instance, a woman's place is thought to be restricted to the home and she has few options for economic independence (Ojanuga and Gilbert, 1992). In addition, the cultural institution of purdah segregates Muslim women from public places

and greatly impacts on their health care-seeking behaviour.

Social support from family members was significantly associated with the use of antenatal care. Stressing the role of mothers-in-law in decisions to seek ANC, Simkhada et al. (2010) noted that mothers-in-law sometimes have a positive influence, especially when encouraging women to seek antenatal care, but more often it is negative. The main reasons why mothers-in-law do not support/encourage antenatal check-ups include expectations regarding pregnant women fulfilling their household duties, perceptions that antenatal care was not suitable, as well as strained power relations between mothers-in-law and daughters-in-law.

Maternal education was significantly associated with the use of antenatal care. Education in particular has been identified as relevant in the enhancement of female autonomy in terms of decision making regarding their health. An educated woman with higher socio-economic status has the ability to make appropriate decisions concerning the use of maternal health care. (Abadine et al, 2008). Trinh et al (2007) identified external environment, predisposing characteristics and need as the most related factors to using antenatal care. Acceptability of the provider services which depends on the satisfaction of service is a major determinant of the utilization of antenatal care (Dolla, 2008).

Wealth, parity and age affect a woman's chances of having optimal antenatal care (Mbuagbaw & Gofin, 2011). For instance, poor wealth status and previous maternity experiences of high parity women may present difficulties in the utilization of skilled antenatal care. In addition, younger women tend to be in a high risk group, and thus more likely to use skilled ANC. Other studies in Nigeria found that ethnicity (Babalola & Fatusi, 2009; Ononokpono et al., 2013), income yielding occupations (Oguntunde et al., 2010), gestational age at initial antenatal care booking (Galadanci et al., 2007), and quality of antenatal care (Awusi et al. 2009) were strongly associated with the utilization of ANC.

Community level factors such as availability of sub-centre in the primary sampling unit and distance to the nearest primary health centre were significantly associated with the utilization of antenatal care in Uttar Pradesh (Tiwari, 2010). Women were more likely to use health care services if the health care centers were available and in close proximity to where they reside. Other studies found that Community poverty and community education were strong determinants of maternal health care. For instance, communities with a high concentration of poor households and a low concentration of well-educated residents are not likely to have the

resources necessary to develop, sustain and access high quality health care services (Gage, 2007).

As noted earlier, most previous studies on maternal health care have focused on the individual and familial factors and neglected the moderating effects of community characteristics. An examination of the moderating effects of community factors would help in understanding whether the magnitude of the effects of the individual-level factors will change as a function of some community factors.

From the theoretical perspective, social ecological theory of health promotion developed by Stokols (1996) provided an understanding of how community conditions are related to health behaviour. Social ecological framework emphasized multiple effects and the interrelations between environmental conditions and human behaviour and wellbeing. The theory stresses that environmental settings have multiple, physical, social and cultural dimensions that can influence health outcomes or health behaviour. These include various geographic, architectural, technologic, organizational and socio-cultural conditions that are present within a particular community or cluster, which are linked to health outcomes at both individual and community levels. The social conditions such as the level of education in the community, poverty, proportion of health facility delivery and mass media exposure in the community as well as, physical conditions including urban-rural residence and region of residence could influence the use of antenatal care. Furthermore, cultural conditions such as ethnic origin and religion are important determinants of maternal health care. The ecological framework also emphasized the influence of intrapersonal factors such as maternal education, age and household wealth status on health care behaviour.

The literature has established that both individual and community factors such as community poverty, community education, ethnic origin and maternal education were important determinants of health outcomes (Boco 2010, Gage 2007; Uthman 2010). Motivated by the recent interest in the effects of these factors on health outcomes, this study seeks to investigate whether community factors could moderate the effects of the individual-level factors on maternal health care. Specifically, the objective of this study is to examine whether community factors moderate the association between individual-level education and ethnic origin on the use of skilled antenatal care in Nigeria. We hypothesize that: the magnitude of the effects of education and ethnic origin on the use of skilled ANC will change as a function of community-level factors.

Data and Methods

The data analyzed in this study was drawn from the 2008 Nigeria Demographic and Health Survey (NDHS), a cross-sectional survey designed to provide information on population and health indicators at the national and state levels. The sample frame for 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 Enumeration Areas (EAs). Sample for the survey was selected using a stratified two-stage cluster design, made up of 888 clusters; 286 in the urban and 602 in the rural areas. Of the 888 clusters, data were collected in 886 PSUs. This was because two PSUs could not be accessed due to disturbances in the areas. In all, a total sample of 33,385 women aged 15-49 years and 15,486 men aged 15-59 were selected in the survey. Details of the methods used in the NDHS have been published somewhere (NPC and ICF Macro, 2009). The sample included in the analysis reported in this study was limited to 17560 women who had their most recent delivery in the five years before the survey.

The outcome variable is antenatal care. This is a dichotomous variable coded 1 if a woman received ANC from a skilled health provider (doctor, nurse or midwife) and 0 otherwise. The explanatory variables were grouped into individual- and community-level factors. These variables were selected because the literature shows that they were significantly associated with the use of maternal health care. The individual-level factors include maternal age at last birth, education, religion, ethnic origin, occupation, women's autonomy, and household wealth index. Maternal age was calculated by subtracting the century month code (CMC) of the date of birth of the child from the date of birth reported by the mother and categorized into three groups: 15-24, 25-34 and 35-49. Maternal educational attainment was categorized into three: no education, primary, and secondary or higher. Religion was classified as Muslim, Christian and Traditional religion/Others, while ethnic affiliation was categorized as Hausa/Fulani/Kanuri, Igbo, Yoruba and Others. Occupation was defined as the type of work respondents do. This was re-grouped and categorized as formal employment (professional/technical/managerial/clerical/sales/skilled manual workers), agricultural employment, unskilled manual workers and unemployed. Woman's autonomy is measured as decision making on a woman's own health care. Household wealth index is the DHS wealth index and 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 and type of vehicle). This was divided

into five quintiles and each quintile represents a relative measure of a household's socioeconomic status (Rutstein and Johnson, 2004).

The community level variables examined include place of residence (urban and rural), region of residence, community hospital delivery, community women's education, community mass media exposure, and community poverty. Region of residence was categorized as: North Central, North East, North West, South East, South-South and South West. Community hospital delivery is the proportion of delivery in a health facility in the primary sampling unit (PSU). This measure was divided into three tertiles and categorized as low, medium and high. Community women's education is the proportion of women with secondary and higher in the PSU. The measure was divided into three tertiles and categorized as low, medium and high. Community mass media exposure is the proportion of women exposed to mass media in the PSU. The proportion was divided into three tertiles and categorized as low, medium and high. Community poverty was measured as the proportion of women from the poor and poorest wealth quintiles and the measure was divided into three tertiles and categorized as low, medium and high. The measure was divided into three tertiles and categorized as low, medium and high. The community variables were constructed by aggregating the average scores of individual and household characteristics (educational attainment, place of delivery, mass media exposure and household wealth index) to the community (primary sampling units). These measures were then divided into tertiles, and categorized as Low (lowest tertile), medium (middle tertile) and high (highest tertile). A total of 886 PSUs were represented in this study and each cluster was made up of a minimum of 80 households.

Two levels of analyses were done. First descriptive analysis was done using frequency distributions and cross tabulations; and the statistical significance of the variables were determined by the chi square test of association. Second, a multilevel model was estimated to assess the relationship between the measured individual and community level factors and the outcome variable. Multicollinearity of the variables was tested using variance inflation factor (VIF). The VIF was 1.5, (that is approximately 2). Stata 11.1 software was used for all analyses. Multilevel analysis was considered appropriate in order to account for the hierarchical nature of the DHS data (Antai, 2009). A two-level multilevel logistic regression model was estimated at individual-level (level 1) and community-level (level 2).

According to Vu (2005), a two-level multilevel model for a dichotomous outcome uses a binomial

sampling and a logit link. 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 = $[\Phi_{ij}(1 - \Phi_{ij})]^*$
Predicted log odds $\eta_{ij} = \log [\Phi_{ij}/ (1- \Phi_{ij})]$

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

Where

Φ_{ij} is the probability that the i th individual in the j th 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 i th individual within j th community

In level 2 model for a two-level model for dichotomous outcome, each of the level 1 coefficients, β_{qj} defined in the level 1 model becomes an outcome and can be expressed as follows:

$$\beta_{qj} = \gamma_{q0} + \gamma_{q1}W_{1j} + \gamma_{q2}W_{2j} + \dots + \gamma_{qs}W_{sj} + u_{qj}$$

$$= \gamma_{q0} + \sum_{s=1} S_q W_{sj} + u_{qj} \quad (2)$$

Where

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

W_{sj} are level 2 predictors and u_{qj} is level 2 random effects.

Five models were estimated for the outcome variable. The first model is an empty or null model and does not contain explanatory variables but decomposes the total variance into individual and community components. The second model contained individual-level characteristics to enable the assessment of the effects of the individual-level variables on skilled ANC. The third model contained only the community characteristics and this allowed the assessment of the relation of the community variables to the outcome variable. The fourth model is the full model and contained explanatory variables at both the individual and community levels. This allows the assessment of net effects of individual and community variables on the use of skilled ANC.

Model 5 (Final Model) contained the cross-level interactions between some community variables and maternal education and ethnic origin. This allowed us to estimate whether the magnitude of the effect of maternal education and ethnic origin will change as a function of some community factors (community poverty and community maternal education). These variables were selected based on their strong association with maternal health care indicators in previous studies (Babalola and Fatusi, 2009; Gage 2007).

Odds ratio (OR) and 95% confidence interval, were expressed as fixed effects, while the random effects were expressed as variance partition coefficient (VPC) and proportional change in variance (PCV). The VPC in each Model was calculated based on the linear threshold model method (Merlo et al., 2006). In this case, the individual level variance σ^2_e is equal to $\pi^2/3$ (i.e. 3.29). AIC (Akaike information criterion) was used to test the goodness of fit of the models.

Results

Overall, 45% of the sample belonged to age group (25-34) (Table 1). About (45%) had no education, while the lowest proportion had higher education.

Table 1 Percentage distribution of women by background characteristics and skilled ANC, Nigeria 2008 DHS

Characteristics	All women		Skilled ANC (Provider)	
	%	n	Received %	p-value
Maternal age at birth				<0.001
15-24	36.9	6476	51.9	
25-34	44.7	7847	63.9	
35-49	18.4	3238	55.7	
Educational attainment				<0.001
No education	45.4	7969	31.0	
Primary	22.8	4004	69.1	
Secondary	25.9	4542	86.3	
Higher	5.9	1045	97.8	
Occupation				<0.001
Unemployed	30.4	5312	47.7	
Formal employment	41.4	7235	67.2	
Agricultural employment	17.2	3005	53.5	
Manual workers	10.9	1910	58.2	
Religion				<0.001
Muslims	54.3	9482	42.6	
Christians	44.0	7685	77.9	
Traditional/Others	1.7	297	38.5	
Ethnic origin				<0.001
Hausa/Fulani/Kanuri	39.6	6924	31.8	
Igbo	11.6	2033	88.3	
Yoruba	15.0	2627	88.1	
Others	33.7	5887	65.0	

Women's autonomy (decisions over own health)				<0.001
Wife alone	8.8	1450	73.8	
Wife/husband	33.1	5477	72.4	
Husband alone/Others	58.2	9634	46.7	
Household wealth index				<0.001
Poorest	23.1	4059	23.6	
Poor	22.2	3898	39.9	
Middle	19.0	3332	64.3	
Rich	18.2	3187	82.4	
Richest	17.6	3084	94.1	
Type of place of residence				<0.001
Urban	30.2	5308	84.2	
Rural	69.8	12253	46.6	
Region of residence				<0.001
North Central	14.3	2516	65.3	
North East	15.6	2745	43.1	
North West	30.4	5337	31.3	
South East	9.1	1599	87.2	
South South	13.1	2303	70.0	
South West	17.4	3061	87.5	
Community women's education				<0.001
Low	42.6	7487	29.1	
Medium	29.0	5097	72.2	
High	28.3	4976	86.8	
Community hospital delivery				<0.001
Low	40.3	7072	25.2	
Medium	27.4	4807	70.9	
High	32.4	5682	87.8	
Community poverty				<0.001
Low	30.5	5356	90.4	
Medium	29.4	5166	62.2	
High	40.1	7039	30.2	
Community mass media exposure				<0.001
Low	32.9	5779	34.4	
Medium	32.4	5683	60.3	
High	34.7	6098	78.2	

More than half of the entire sample were Muslims and 44% were Christians. With respect to occupation, 41.4% of the sample population were in formal employment, 30.4% were unemployed, 17.2% were in the agricultural sector while 10.9% were manual workers. Ethnic origin of women reflected the dominance of Hausa ethnic group (40%). About 12% of the women were Igbo, 15% were Yoruba and 33% belonged to the minority ethnic groups. Almost two third of the sample population reported that their husbands or other people have a final say on their utilization of health care. About 45% of the women were from the two poorest wealth quintiles, while the lowest proportion were from the richest wealth quintile.

Majority of the sample population (70%) lived rural areas. Also, one third of the women resided in North West, while the lowest proportion lived in South East. Over a third of the study sample lived in communities with a low proportion of educated women, and a low proportion who delivered in a

health facility. About 40% of the women lived in high poverty communities, whereas over a third lived in communities with a high proportion of women who were exposed to mass media.

The bivariate results in Table I show that all the explanatory variables were significantly associated with the use of skilled antenatal care ($p < 0.001$). Younger women (25-34 years), those who had secondary/higher education, women who were in formal employment, Christian women, and women who belonged to rich households had a higher frequency of ANC utilization. The proportion of skilled ANC utilization was highest among women who reported that they make decisions alone (73.8%) and jointly with their husbands (72.4%) on their own health care. The proportion of women from Igbo, Yoruba and other minority ethnic groups who used skilled ANC was higher than women from Hausa/Fulani/Kanuri ethnic group. Women who lived in urban areas had a higher proportion (84.2%) of skilled ANC utilization than rural women. The frequency of the use of skilled ANC was lowest for women from North West (31.3%) and North East (43.1%). The proportion of skilled ANC utilization was higher for women who lived in communities with a high proportion of educated women, a high proportion who had health facility delivery, and a high proportion who were exposed to mass media than women who resided in disadvantaged communities. Conversely, the lowest proportion of antenatal care utilization was found among women who lived in communities with a high proportion of women from poor households.

Multilevel analysis

Results in model 0 (null Model) (Table 2) indicate a significant variation in antenatal care across communities ($\tau = 6.290$, $p = 0.001$). The intra-community correlation coefficient (ICC) of 65.6% was related to skilled ANC at the community level. Model I shows the effects of the individual covariates. Only the individual variables were included in this model to examine the independent effects of the individual covariates on skilled ANC. Results reveal that maternal age at last delivery and a woman's autonomy were not significantly related to the use of skilled antenatal care. Women with primary (OR= 2.07, $p < 0.001$) and secondary/higher (OR= 3.76, $p < 0.001$) education were more likely to use skilled ANC compared to women who had no schooling. Traditional religious women had a lower likelihood of skilled ANC utilization. Women of Igbo (OR=7.02, $p < 0.001$) Yoruba (OR=4.46, $p < 0.001$) and other minority ethnic origin (OR=2.56, $p < 0.001$) had higher odds of skilled antenatal care utilization than Hausa/Fulani/Kanuri women.

Similarly, women who worked in the formal sector exhibited a higher likelihood of using skilled antenatal care compared to women that were unemployed. As expected, the household wealth index was significantly associated with antenatal care. The odds of ANC utilization was higher for women from richest households (OR=10.11, $p<0.001$) compared to women from poorest households.

The variance in model 1 was significant ($\tau = 2.095$; $p<0.001$). The intra-community correlation decreased to 38.9% and the proportional change in variance of receiving skilled antenatal care across

communities was 67%. The addition of the individual level variables helped to reduce the community variance from 6.290 to 2.095 ($p<0.001$). This indicates that the individual factors were important in explaining the variability in the use of skilled ANC between communities.

Model 2 contained only the community-level variables to enable the assessment of the independent effects of the community-level covariates. Results show that living in North- East (OR=0.62, $p<0.001$), North-West

Table 2 Multilevel logistic regression odds ratio of the effects of individual and community factors on antenatal care from skilled health provider, Nigeria 2008 DHS

Variables	Model 0 Empty model	Model 1 Individual /household variables	Model 2 Community variables	Model 3 (Full model) Individual/ community variables	Model 4 (Final Model) Community poverty x education & Community women's education x ethnic origin
		Odds Ratio (95% CI)	Odds Ratio 95% CI)	Odds Ratio (95% CI)	Odds ratio (95% CI)
Fixed effects					
Individual characteristics					
Maternal age at last birth					
15-24		1.00		1.00	1.00
25-34		1.04 (0.94-1.16)		1.03 (0.92-1.14)	1.01 (0.91-1.11)
35-49		0.96 (0.84-1.09)	-	0.93 (0.82-1.07)	0.89 (0.78-1.01)
Educational attainment					
No education		1.00		1.00	-
Primary		2.07*** (1.82-2.35)	-	1.99*** (1.61-2.46)	
Secondary/Higher		3.76*** (3.18-4.45)		3.64*** (2.60-5.10)	
Religion					
Muslims		1.00	-	1.00	1.00
Christians		0.98 (0.81-1.21)		0.89 (0.72-1.12)	1.03 (0.84-1.27)
Traditional/Others		0.53*** (0.37-0.77)		0.52*** (0.34-0.79)	0.56** (0.39-0.82)
					-

Ethnic Origin

Hausa	1.00	-	1.00
Igbo	7.02*** (4.84-10.19)	-	3.38*** (1.88-6.08)
Yoruba	4.46*** (3.26-6.10)	-	1.73** (1.17-2.55)
Others	2.56*** (2.09-3.15)	-	1.98*** (1.51-2.59)

Occupation

Unemployed	1.00	-	1.00	1.00
Formal employment	1.37*** (1.21-1.55)	-	1.36*** (1.18-1.56)	1.34*** (1.22-1.56)
Agric employment	0.99 (0.85-1.17)	-	1.01 (0.86-1.19)	0.98 (0.83-1.16)
Unskilled manual workers	1.48*** (1.23-1.78)	-	1.53*** (1.25-1.89)	1.61*** (1.33-1.93)

Women's autonomy

Wife alone	1.00	-	1.00	1.00
Wife/Husband	1.41 (1.16-1.71)	-	1.44*** (1.17-1.78)	1.42*** (1.17-1.72)
Husband alone/Others	1.09 (0.91-1.33)	-	1.17 (0.96-1.43)	1.16 (0.95-1.39)

Household wealth index

Poorest	1.00	-	1.00	1.00
Poorer	1.44*** (1.26-1.66)	-	1.34*** (1.14 - 1.57)	1.32*** (1.16-1.52)
Middle	2.55*** (2.17-3.01)	-	1.98*** (1.56 - 2.51)	1.98*** (1.67-2.34)
Richer	4.32*** (3.54-5.28)	-	2.73*** (1.98 - 3.76)	2.84*** (2.31-3.51)
Richest	10.11*** (7.59-13.47)	-	5.24*** (3.29 - 8.34)	5.45*** (4.02-7.41)

Place of residence

Urban	-	1.00	1.00	-
Rural	-	0.80 (0.60-1.07)	0.82 (0.61-1.10)	-

Region of residence

South West	1.00	1.00	1.00
North Central	0.62** (0.58-1.23)	0.94 (0.69-1.64)	0.96 (0.62-1.46)
North East	0.27*** (0.34-0.80)	0.42*** (0.62-1.62)	0.92 (0.57-1.46)
North West	1.72** (0.13-0.38)	0.79 (0.26-0.75)	0.43*** (0.26-0.69)
South East	0.46*** (0.93-2.28)	0.33*** (0.43-1.62)	0.83 (0.43-1.61)
South South	1.17 (0.25-0.61)	0.93 (0.20-0.58)	0.34*** (0.21-0.53)

Community women's education

Low	1.00	1.00	-
Medium	2.37*** (1.61-3.49)	1.29 (0.94-1.78)	
High	2.58*** (1.62-4.12)	0.94 (0.62-1.42)	

Community hospital delivery

Low	1.00	1.00	1.00
Medium	3.20*** (2.05-4.99)	2.86*** (1.95-4.18)	2.62*** (1.96-3.62)
High	4.11*** (2.41-6.98)	3.75*** (2.35-5.99)	3.59*** (2.51-5.14)

Community poverty

Low	1.00	1.00	-
Medium	0.51*** (0.36-0.72)	0.88 (0.64-1.24)	
High	0.23*** (0.14-0.39)	0.54** (0.36-0.83)	

Community mass media exposure

Low	1.00	1.00	1.00
Medium	2.02*** (1.47-2.77)	1.99*** (1.48-2.69)	1.98*** (1.53-2.54)
High	2.48*** (1.67-3.70)	2.23*** (1.54-3.22)	2.28*** (1.66-3.14)

Community poverty x education

Low poverty x none/primary	-	-	-	1.00
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Medium poverty x Sec/higher					1.82** (1.27-2.59)
High poverty x Sec/higher					1.25 (0.80-1.93)
Community women's education x ethnic origin					
Low x Hausa/Fulani/Kanuri					1.00
Medium x Hausa/Fulani/Kanuri					1.62* (1.08-2.45)
High x Hausa/Fulani/Kanuri					1.78 (0.96-3.31)
Medium x Igbo					4.19*** (2.20-8.00)
High x Igbo					6.21*** (2.94-13.11)
Medium x Yoruba					2.84*** (1.63-4.96)
High x Yoruba					1.46 (0.82-2.59)
Medium x Others					3.56*** (2.46-5.15)
High x Others					2.24*** (1.41-3.55)
Random effects	Empty	Individual	Community	Individual/ Community	Interaction
Community level					
Variance(SE)	6.290***(0.417)	2.095*** (0.160)	1.568***(0.413)	1.446***(0.331)	1.361*** (0.110)
(VPC)=ICC (%)	65.6	38.9	32.2	30.5	29.26
PCV (%)	Reference	66.7	75.1	77	78.4
Log-likelihood	-8221.3601	-6887.8711	-7741.1444	-6722.5575	-6761.1513
Model fit statistics					
AIC	16448.7	13817.7	15516.3	13515.1	13604.3

Note: Educational attainment, ethnic origin, community women's education and community poverty were not included in the final model to prevent collinearity. 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<0.05

(OR=0.27, $p<0.001$) and South-East (OR=0.46, $p<0.001$) was associated with lower odds of using skilled antenatal care compared to living in South-West. The odds of receiving skilled ANC was twice higher for women residing in communities with a high proportion of educated women and a high proportion who were exposed to mass media, whereas the odds were 4 times higher for women who lived in communities with a high proportion of health facility delivery. However, women who lived in high poverty communities were less likely to use skilled ANC compared to those who lived in low poverty communities.

In comparison to model 1 the community variance remained significant ($\tau = 1.568$, $p = 0.001$). The intra-community correlation decreased further to 32.2 %. The proportional change in variance was estimated at 75%. This shows that including community level factors in this model helped to reduce the community variance from 2.095 ($p = 0.001$) to 1.568 ($p = 0.001$).

Both the individual-level and community-level characteristics were included in model 3 which is the full model. The individual-level factors such as maternal educational attainment, religion, occupation, ethnic origin, a woman's autonomy and household wealth index were significantly associated with the use of skilled ANC. However, result indicates a slight reduction in the odds of skilled ANC utilization across almost all variable categories at both individual and community levels. Similarly, community-level characteristics such as region of residence, community hospital delivery (OR = 3.75, $p<0.001$), community poverty (OR = 0.54, $p<0.01$) and community mass media exposure (OR = 2.23, $p<0.001$) were significantly associated with skilled ANC.

When compared to model 2, the variation in ANC across communities was significant ($\tau = 1.446$; $p<0.001$). The intra-community correlation was 30.5%, while the proportional change in variance was estimated at 77%. The inclusion of the individual and community-level factors reduced the community variance from 1.568 ($p = 0.001$) to 1.446 ($p = 0.001$) indicating that both individual and community factors were important determinants of the use of skilled ANC.

As shown by the cross level interaction term in Table 2 (Model 4) among women who had secondary/higher education, the use of skilled antenatal care significantly increased by residence in medium poverty communities (OR = 1.82, 95% CI: 1.27-2.59, $p<0.01$). For Hausa/Fulani/Kanuri (OR = 1.62, CI=1.08-2.45, $p<0.05$) and Yoruba (OR= 2.84, CI: (1.63-4.96, $p<0.001$)) women, residence in

communities with a medium proportion of educated women increased the odds of receiving skilled ANC. In addition, Igbo women (OR=6.21, CI: 2.94-13.11, $P<0.001$) and women from other minority ethnic groups (OR=2.24, CI: (1.41-3.55, $p<0.001$)) who resided in communities with a high proportion of women who had secondary and higher education had higher odds of using ANC from a skilled health provider.

The lower values of AIC in the model indicate a significant improvement of each of the models over previous model.

Discussion

This study has clearly demonstrated that the inclusion of community level variables was important in explaining the variations in the use of skilled antenatal care. Community-level variables such as region of residence, community hospital delivery, community poverty, and community mass media exposure had strong independent effects on the use of skilled antenatal care. The use of skilled ANC varied across regions. The odds of ANC utilization was higher in South West compared to other regions of Nigeria. The higher likelihood of ANC utilization found among women residing in South Western region is consistent with other studies in Nigeria (Adamu, 2011; Doctor, 2011; NPC & ICF Macro, 2009). The finding demonstrates that in Nigeria, the characteristics of the region in which women reside influence their utilization of maternal health care services; and suggests differences in socioeconomic development. Furthermore, the result points to the need for regional specific interventions to address the disparities in maternal health care. A better targeting of health policy and planning to enable equitable distribution of need-based resources across the various regions of the country will help to improve the health care system and other infrastructures, which in turn will increase women's access to and demand for maternal health care services.

The study provides evidence that living in communities with a high proportion of women who delivered in a health facility increased the odds of skilled ANC utilization. The finding re-iterates the point that a woman's decisions to use maternal health care may be influenced by availability of health facility and quality of health care in the community (Antai, 2009; Stephenson et al 2006). Living in communities with a high proportion of women from poor households decreased the odds of skilled ANC utilization. This finding lends support to a previous study on reproductive health behaviour (Uthman, 2010). Poverty is a condition of not having enough income to meet basic needs such as food, clothing

and shelter (Vu, 2005). Women, particularly the unemployed are often dependent on their husbands or other family members and are more likely to experience poor maternal health outcomes. From policy standpoint, women from poor households should be empowered economically. Programs to address the issue of community poverty should include strategies to promote economic growth in the community, reduce unemployment and removal of other barriers that prevent economically disadvantaged populations from gaining employment (Shah, 1994).

The odds of skilled ANC utilization were higher for women who lived in communities with a high proportion of women who were exposed to mass media. Living among women who are exposed to any form of mass media could lead to greater awareness of maternal health care services. Furthermore, exposure to mass media may influence women's social attitudes and increase their potential to use skilled ANC. This strongly suggests the need for effective media campaigns regarding the importance of health care services.

At the individual level, educational attainment, occupation, ethnic origin, household wealth index, occupation and religion were significantly associated with the use of skilled ANC. These results are consistent with studies elsewhere (Islam & Odland 2011; Kistiana, 2009; Dhaher et al. 2008). Educational attainment, occupation and household wealth status may increase a woman's decision-making power within the household (Matsumura & Gubhaju 2001) and build greater confidence and capability to make decisions concerning her own health (WHO & UNICEF 2003). Thus socio-economic empowerment of women may have a reinforcing effect on improved utilization of maternal health care (Amin et al. 2010).

The effect of ethnic origin (cultural variable) may suggest differentials in socio-economic and cultural characteristics of the different ethnic groups which could influence health care behaviour. For instance, women in some cultures may not seek health care services due to cultural requirements of seclusion (Mesko et al. 2003). Thus the Islamic cultural or religious practices of *purdah* (seclusion) in Northern Nigeria could contribute to the low utilization of skilled ANC found among Hausa women.

The effect of community poverty and its interaction with maternal education indicates that the odds of ANC utilization increased for women with secondary/higher education resident in low and medium poverty communities. Meanwhile, residence in communities with a high proportion of educated women increased the odds of skilled ANC utilization among women from the entire major and minority ethnic groups. Living in low poverty communities and communities with a high proportion of educated

women could enhance women's social and economic status which in turn could increase the use of antenatal care.

The significance of the random intercept highlights the presence of variables that could not be controlled in the multilevel analysis, particularly issues surrounding access to health care such as availability of and actual distance to the health facility which have been established in previous studies to be important determinants of maternal health care utilization (Do, 2008; Mistry et al., 2009). Unfortunately, the analysis could not address the effects of these omitted variables because they were not included in the DHS dataset. Hence, there is need for further research to investigate the unmeasured factors that may account for the unexplained community variations in the outcome variable in this study.

The study has some limitations that are worthy of consideration. The use of the DHS primary sampling unit as the community may bias results due to selection effects. Selection bias recognizes the fact that individuals or families have some degree of choice regarding the communities in which they live (Vu, 2005). In consideration of this fact, if important unmeasured individual characteristics influence the choice of individuals (women) to live in certain kinds of communities which influence their health care behaviour either positively or negatively, then the observed effects of community level factors in this study may have been biased.

Some important individual and community factors known to influence service utilization were not included in this study due to limitation of the NDHS data. For example, actual distance to health facility and perceptions of the use of health services. The omission of these important confounders may have biased the estimates of the measured variables in this study.

The study is associated with the problem of 'atomistic fallacy'. The community variables were constructed by aggregating the individual level characteristics at the community level, thus making inferences at a higher level based on information from data collected at the individual level (Boco, 2010).

Despite the identified limitations, the study provides empirical evidence that the community is important in the understanding of variations in the utilization of skilled antenatal care. Moreover, the moderating effects of community factors found in this study, was important in the identification of the community conditions necessary for interventions.

Conclusion

Community characteristics were important in explaining the variations in the use of skilled ANC. More importantly, community factors moderated the

association between selected individual factors (education and ethnic origin) and the utilization of skilled antenatal care. The results suggest that improvement in the use of skilled ANC requires increased investment in women's secondary education at the community level. Programs that target poverty alleviation and empowerment of women socially and economically should be encouraged, particularly in disadvantaged communities. These programs have the potential to help women secure means of livelihoods and increase their decision making power regarding the use of maternal health care services.

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