Regional Inequalities in Under-five Mortality in Nigeria: a Multilevel Analysis

By

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Abstract

Substantial regional disparities in childhood mortality exist in Nigeria. Consequently, studies have attempted to investigate the socio-cultural dimension of this. However, much of these have not focused on ecological and community contextual diversities as predictors of childhood mortality in Nigeria. Whereas, Evidence suggests that living in an economically and socially deprived community is associated with increased risk of under-five mortality. Using 2008 Nigeria Demographic and Health Survey, we contribute to the global discourse on place effect on mortality by examining the influence of community-level characteristics (as opposed to individual-level attributes) on childhood mortality in Nigeria. Multilevel Cox proportional hazards analysis was performed on a nationally representative sample of 28,647 children nested within 18,028 mothers of reproductive age, who were also nested within 886 communities. Measures of association among characteristics were expressed using hazard ratios (HR) with 95% confidence intervals (CI). Results indicate that risks of death were almost twofold higher for children residing in the North-east and North-west regions (HR: 1.90, CI: 1.35-2.70, $p<0.001$) compared with children in the South-west region of the country. Risks of death were lower for children of mothers residing in communities with a high proportion of mothers attending prenatal care by a doctor ($p<0.05$); and for children of mothers residing in communities with a high proportion of mothers who had hospital delivery (HR: 0.70, CI: 0.61-0.81, $p<0.05$). These findings suggest the need to look beyond individual-level factors by focusing attention on community-level interventions aimed at improving child health and survival in the country's economically and socially deprived communities.

Keywords: Under-five, Mortality, Regional inequality, Contextual factors, Nigeria

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1. Introduction

Studies have long established a significant relationship between child survival and individual-level characteristics such as maternal education and other socio-economic characteristics (Adeboye et al, Adetunji, 1995; Anand, 1999; Anyamele, 2009; Argeseanu, 2004; Buor, 2002; Chirdan et al., 2008; Collins., 2004; Fayeun & Omololu, 2011; Lawoyin, 2001; Lykens et al., 2009; Masuy-Stroobant Godelieve, 2001; Nwokocha & Awomoyi, 2009; Odimegwu, 2002; Zaba & Patricia, 1996). Other studies have also shown that some attributes of the community where children are raised tend to influence the mortality risks of the children (Adekanmbi et al., 2011; Adjuik et al., 2010; Antai, 2011b; Antai & Moradi, 2010a; Babalola & Fatusi, 2009; Boco, 2010; Olalekan & Kongnyuy, 2008; Sastry, 1996; Shabani et al., 2010; Uthman, 2008). Growing body of evidence also suggests that living in an economically and socially deprived neighbourhood is associated with increased risk of under-five mortality (Antai & Moradi, 2010b; Aremu et al., 2011).

Nigeria being the most populous country in Africa is characterised by socially and economically advantaged and disadvantaged regions. The country is geographically, religiously, socially, ecologically and economically diverse. This has led to a varied disease exposures and different child health outcomes (Adekanmbi, et al., 2011; Akinbami et al., 2010; Chirdan, et al., 2008; Grais et al., 2007; Lawoyin, 2001; Okoro et al., 2009; Oniyangi et al., 2006; Udo et al., 2008; Wall, 1998). From the arid northern region of the country to the savannah west; from the predominantly Islamic North-west to the South-east vastly dominated by Christians, the country is highly heterogeneous and diverse. As a result, this has led to huge diversities in regional environment, cultural practices (Antai, 2011a; Antai et al., 2009), health-seeking practices (Adeboye, et al., 2010; Antai, 2009; Babalola & Fatusi, 2009), socio-economic positions (Antai, 2011a; Aremu, et al., 2011) and the political milieu.

To date, Nigeria has a very high rate of under-five mortality and the rate is among the highest in the world. About 1 in every 5 children born in the country dies before the age of five (National Population Commission & ICF Macro, 2009). Worse still, infant and child mortality rates vary substantially from one region of the country to the other. For instance, under-five mortality rate ranges from 89 per 1000 live births in the South-west to 222 in the North-east. Besides, Nigeria is not making sufficient progress towards the attainment of Millennium Development Goal four (MDG4). For instance, under-five mortality rate in the country for the 1999-2003 period was 201 per 1000 live births, while the rate has marginally declined to 157 per 1000 live births during the 2004-2008 period (National Population Commission (NPC) [Nigeria] and ORC Macro, 2004); NPC & ICF Macro, 2009). In addition, as earlier noted, Nigeria is by far the most populous country in Africa and she has a very huge childhood population. According to 2006 population and housing census, Nigerian's population is 140,431,790 and the population of the under-five children is 16.1% of the total population (National Population Commission, 2009).

Furthermore, despite the improvement in medical technology, reports by NPC and ICF Macro (2009) indicate that Nigeria is still being ravaged by several health challenges. These include high rates of under-five mortality (157 per 1000 live births), high teenage pregnancy (23% of young women aged 15-19 are already giving births), many poor pregnancy outcomes (such as stillbirth, spontaneous abortion, and low birth weight), poor survival chances for the newborn, and high unmet need for family planning (20% of currently married women have an unmet need for contraception in the country). Also, the percentage of births assisted by unskilled birth attendants is 60% in the country (NPC & ICF Macro, 2009). The list of the public health problems is indeed endless in Nigeria. It is momentous studying a country with such diversities and myriad of health challenges.

Meanwhile, while many studies have been conducted on under-five mortality in Nigeria as in other developing countries, Nigerian studies have less attention on the influences of contextual

factors on child survival. As earlier pointed out, several studies e.g.; (Adeboye, et al., 2010; Adetunji, 1995; Akinbami, et al., 2010; Brown et al., 2008; Ekenze et al., 2009; Lawoyin, 2001; Nwokocha & Awomoyi, 2009) have come no closer than examining the effects of individual-level characteristics. Whereas, literature shows that knowledge about the determinants of child mortality at the individual level is insufficient to address the problem (Antai, 2011b; Griffiths et al., 2004; Harttgen & Misselhorn, 2006; Omariba et al., 2007; Sastry, 1996; Whitworth & Stephenson, 2002). This is because the contextual characteristics of the community or neighbourhood where a child is raised tend to modify individual- and household-level factors and therefore affect child survival. To this end, this study aims to contribute to the global debate on the effect of place on mortality risks by examining the influences of community contextual factors on regional inequalities in under-five Mortality in Nigeria.

This paper is structured as follows. Some theoretical perspectives on how community contexts influence child survival is discussed in section 2. Section 3 presents the data source and method. Section 4 presents the results. Section 5 discusses the results and conclusions drawn from the results.

2. Risks of childhood mortality and community contexts: Some theoretical perspectives

From theoretical standpoint, Mosley and Chen's (1984) model on the proximate causes of childhood mortality establishes a relationship between child survival and determinants at various levels of operation – individual, household, and community-levels (as cited in WHO, 2003). Diez-Roux and colleagues (2001) posited that the physical and social characteristics of neighbourhood where a person lives may affect health and health-related behaviour. Galster's (2010) work on the mechanisms of neighbourhood effects theory observed a link between residential environment and health outcomes of individual adults and children residing in such environment or community.

Also, premised on the social capital theory, Lochner and colleagues' (2003) study established an association between trust, reciprocity, civic participation and neighbourhood death rates.

Specifically, the effect of community context in which a child is raised on child's survival has been widely recognised (Antai, 2011a, Omariba et al, 2007, Sastry, 1996, Sastry, 1997). Evidence suggests that living in an economically and socially deprived community or neighbourhood is associated with increased risk of under-five mortality (Antai & Moradi, 2010b; Aremu, et al., 2011); and children from the same community tend to share the same environmental conditions. For instance, children raised in a community that lacks electricity, good drinking water and health facility are likely to suffer from the same deprivation which can directly or indirectly influence their health outcomes.

Further, Manda (2001) opined that Demographic and Health Surveys (DHS) often collect birth history data that are clustered at the household and community levels. Sastry (1997) as well maintains that most demographic surveys conducted in the developing countries often collect survival data that are clustered at both family and community-levels. Omariba and colleagues (2007) also argue that since DHS collects child survival data from mothers in sampled households, then the children of those mothers cannot be regarded as independent observations. This is as a result of natural clustering or as a result of the data collection procedures[6] used in DHS data collection (Sastry, 1997). The children from sampled households who are also nested within the same mother-level tend to share similar characteristics and common genetic factors. This is also true of children from the same community. Individuals in the same community are likely to be more homogenous than those from different communities. Similarities are expected in the health outcomes of children who are exposed to the same environmental conditions. By contrast, differences are expected in health outcomes of children raised in different communities due to differences in community characteristics (Harttgen & Misselhorn, 2006).

[6] Two-stage cluster sampling design

A distinction is drawn between children living in a relatively better-off neighbourhood and those living in a relatively worse-off neighbourhood (Macintyre et al., 2002). Children living in two different households with similar socio-economic characteristics can suffer different mortality risks if they are from two contrasting communities. Sastry (1997) contends that community characteristics can exacerbate or mitigate mortality risks of individuals depending on the environmental context the individuals find themselves. Griffiths (2004) also argues in support that community services and levels of infrastructural development of a community are capable of amplifying or reducing mortality risks among the children. This is because an individual child resident in a household unit, which in turn is located within a community, is exposed to various levels (within the societal hierarchy) that either directly or indirectly influence his or her survival chances.

In addition, Whitworth and Stephenson (2002) maintain that two neonates with similar characteristics may suffer a different neonatal mortality risk because of the community contextual effects. The authors argue that these differentials in mortality risks may be as a result of differences in the provision of antenatal and obstetric health care or the effects of environmental conditions the children are exposed to. Also, individuals residing in the same community tend to share similar preferences, cultural practices, values and customs. The reason is that individuals with similar tastes and values tend to cluster and live together (Sastry, 1997). All these clustering and living together of people with common norms, values, identities and cultural practices as well as spatial inequality in infrastructural development (Antai, 2011b) have a direct bearing on the health outcomes of under-five children and this often brings about variations and differentials in health outcomes between communities, particularly communities with contrasting characteristics.

The motivation for this paper is as a result of emerging interest in the study of effects of community or neighbourhood context on health outcomes as well as the reason of conflicting evidence on the level and extent of the effects of place or community context on health outcomes

in developing countries. This paper thus contributes to the discussion on the effects of community contexts on health by examining the extent to which community contextual factors influence regional variation in under-five mortality in Nigeria.

3. Data Source and Method

3.1 Data Source

This study utilizes 2008 Nigeria Demographic and Health Survey (2008 NDHS). The survey elicited information on demographic and health indicators at the national, regional and state levels. The primary sampling unit (PSU) which was regarded as a cluster for the 2008 NDHS is defined on the basis of Enumeration Areas (EAs). Sample for the survey was selected using stratified two-stage cluster design consisting of 888 clusters (NPC and ICF, 2009). In all, a nationally representative sample of 36,800 households was selected for the survey. Birth history data were collected from 33,385 women of childbearing age. The community-level variables were measured at the level of the PSU which serves as proxies for communities or neighbourhoods. PSUs refer to small and administratively defined areas and one PSU is a cluster which consisted of at least 50 fairly homogenous households or units. In 2008 NDHS, data were collected in 886 PSUs, while 2 PSUs could not be accessed due to disturbances in the areas. A full report of the data collection procedures for the 2008 NDHS is available elsewhere (NPC and ICF Macro, 2009).

In the 2008 Nigeria Demography and Health Survey, birth history data were collected from 33,385 women age 15-49 years. These include sex of child, month and year of child's birth, child's survivorship status, child's current age and age at death if the child had dead. The analysis for the present paper was restricted to 28,647 live born children produced by 18,028 women within the

five years before the survey[7]. The 28,647 live born children were nested within the 18028 women, who were in turn nested within 886 communities selected across the 6 geo-political regions of the country.

3.2 Ethical Considerations

This study was based on secondary analysis of existing dataset with all participant identifiers removed. The survey instruments received ethical approval from the National Ethics Committee in the Federal Ministry of Health, Abuja, Nigeria; and from the Ethics Committee of the Opinion Research Corporation of the Macro International Inc., Calverton, MD, USA. Permission to use the 2008 Nigeria DHS data in this study was obtained from ICF Macro Inc.

3.3 Variables Measurement

3.3.1 Outcome variable

The outcome variable for this study is the risk of death in infancy or childhood which is measured as the duration of survival since birth in months. This is defined as either the risk of a child dying between birth and first birthday (infant mortality) or the fifth birthday (under-five mortality). Analysis was child-based and as earlier noted; analysis was restricted to the births in the last five years before the survey. Hence, all children born within the five years before the survey date were included in the analysis. Specifically, all deaths that occurred from age 0 to 59 months were regarded as cases. The children's survival status and the age at death in months (if the child had died) or the last month that they were known to be alive (if child is still living) were combined to generate the outcome variable for the survival analysis. Children known to have died (i.e. non-

[7] This was with a view to ensuring that the study provides an accurate picture of the current situations in the various geo-political regions of the country

censored) were regarded as the cases, whereas children who were still alive after 11 months (in the case of infant mortality) or after 59 months (in the case of under-five mortality) were treated as right-censored.

3.3.2 Exposure variables

3.3.2a Community Contextual Factors

The contextual characteristics of interest in this study included (1) place of residence [categorised as (a) urban (b) rural]; (2) region of residence [defined as the regions where the children are raised, and categorised as (a) North-Central, (b) North-East, (c) North-West, (d) South-east, (e) South-South and (f) South-West]; (3) community economic status [defined as the average economic status of women in the community, and categorized as (a) poor (b) middle and (c) rich. Other contextual characteristics were (4) community maternal level of education [defined as the proportion of women who had at least secondary education in the community and categorised as (a) low (b) middle (c) high]; (5) community hospital delivery [defined as proportion in the community who had hospital delivery and categorised as (a) low (b) middle (c) high]; (6) community prenatal care by doctor [defined as the proportion of mothers who attended prenatal care by doctor in the community and categorised as (a) low (b) middle (c) high].

3.3.2b Individual-level attributes

The important individual-level characteristics assessed in this study are as follows: (1) mother's education [categorised as (a) no education, (b) primary, (c) secondary and higher]; (2) mother's occupation [categorised as (a) not working, (b) professional (c) sales (d) manual]; (3) birth order [defined as birth order of the child and categorised as (a) first births (b) 2-4 birth order (c) birth

order 5+]; (4) sex [defined as sex of the child and categorised as (a) male (b) female]; (5) marital status [defined as mother's marital status and categorized as (a) single (b) married (c) divorced]; (6) maternal age [grouped as (a) 15-24 years, (b) 25-34 years, and (c) 35 years and older]; (7) age at first birth [defined as mother's age at birth of first child and grouped as (a) less than 18 years (b) 18 years or higher]; (8) religious affiliation [categorised as (a) Christianity (b) Islam (c) Traditional]; and (9) wealth index [categorised as (a) poor (b) middle (c) rich]. The wealth index is the proxy indicator of the household socioeconomic status. This was derived based on the scores allocated to various household possessions. Wealth index was applied in this analysis as a composite index and an indicator of the socioeconomic status of households. This was because the Demographic and Health Survey generally does not collect information on household income or wealth. Weights generated by principal component analysis are assigned to information on household assets collected through the DHS surveys. These household assets include household items and durable assets.

3.4 Statistical Analysis

Both descriptive and inferential statistics were employed in this paper. First, characteristics of children and women were presented using descriptive statistics. Second, Cox proportional hazard models were fitted separately for infant mortality and separately for under-five mortality. Third, further analysis was done using multilevel Cox proportional hazards regression analysis. We employed multilevel Cox proportional hazards model for two reasons. First, Cox-proportional hazards model (i.e. multilevel survival analysis) is appropriate in analysing censored observations. This means that, using Cox-proportional hazards regression analysis, both the occurrence of childhood mortality and the time when the infant or the child died were considered as the outcome

variables. The probability of childhood death is regarded as the hazard. The hazard was modelled using the following lines of equation:

$$H(t) = H_0(t) \times \text{esp}(b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_KX_k \quad (1)$$

Where X_1 ... X_k are a collection of explanatory variables and $H_0(t)$ is the baseline hazard at time t, representing the hazard for a person with the value 0 for all the explanatory variables. However, by dividing both sides of equation 1 by $H_0(t)$ and taking logarithms, the equation 1 becomes:

$$\ln\left(\frac{H(t)}{H_0(t)}\right) = b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_kX_k \quad (2)$$

Where $H(t) / H_0(t)$ is regarded as the hazard ratio. The coefficients $b_i...b_k$ are estimated by Cox regression.

Second reason for using multilevel Cox proportional hazard model was to account for the hierarchical structure of the DHS data. The assumption is that "individuals (level 1) are nested within households (level 2), and households are nested within communities (level 3)",(Harttgen and Misselhorn, 2006:6). This suggests that children in households with similar characteristics can have different health outcomes when residing in different communities with different characteristics.

We separately analysed and assessed the associations between under-five mortality and community-level characteristics in order to examine the extent to which the covariates at community level influence the regional variations in under-five mortality in Nigeria. In our analysis, we expressed measures of association (fixed effects) as hazard ratios. The multilevel Cox regression analysis was done in this study using the generalized linear latent and mixed models (GLLAMM) procedure in STATA.

We fitted three multilevel models (apart from model 0 – i.e. the empty model which was fitted to decompose the total variance into individual- and community-level components. Since the focus of this study was to examine the extent to which contextual factors influence regional variations in under-five mortality in Nigeria, hence, model 1 in our multilevel analysis contained region of residence as the only covariate. Model 2 builds on model 1 by including all other contextual characteristics. To adjust for the effect of the individual-level attributes, we included individual-level factors in model 3. All analysis was done using STATA software (version 11.1). Weighting factors were applied to adjust for oversampling of some regions and locations in the survey.

4 Results

4.1 Socioeconomic and demographic characteristics of children and their mothers by region of residence

Data for this study were extracted from a larger study with the sample size of 33,385 women. As earlier noted, analysis for the present paper was restricted to 18,028 women who had a total of 28,647 live births within the five years before the survey.

The distribution of the study population by socioeconomic and demographic characteristics according to region of residence is presented in Table 1. The results indicate that, with the exception of child's sex, all the selected characteristics vary significantly between the regions of residence. Findings showed that male and female children were almost of the same proportion (i.e. 51% vs. 49%). With respect to birth order, overall for the whole country, almost 2 in 5 children (35.7) were of birth order 5 or higher. The South-west region fared better in terms of birth order as 20% of the children belonged to birth order 5 or higher while the North-east and North-west were more than doubled (43%) that of the South-west. Also, a consideration of maternal age showed that higher proportion of mothers from South-east (62%), South-south (58%) and South-west

(56%) had at least secondary education, while the majority of mothers from the North-west (78%) and North-east (74%) had no education. Results further showed that, overall, the children predominantly belonged to married women in all the regions, and were more of children of mothers within age bracket 25-34. With respect to mother's occupation, in all the regions, mothers were less likely to be professionals. Data revealed that they were more into sales and manual works. Results also showed that more than half of mothers from North-east and North-west were teenagers at the birth of their first child, while predominantly high proportion of mothers from the South-east and South-west was age 18 years or older at the birth of their first child.

Considering religious affiliation of mothers, those residing in the South-east were predominantly Christian (95.7%) while mothers from North-west were mostly Muslim. Also, about 3 in 4 children from North-east were from poor household as against the same proportion in the South-west who were from rich household.

TABLE 1: Percentage distribution of child- and mother-level characteristics by geo-political regions

Variables/ Categories	Nigeria % (n)	Regions						P-value
		North-Central %	North-East %	North-West %	South-East %	South-West %	South-South %	
Regions of residence	100 (28,647)	17.6 (5046)	22.9 (6559)	27.7 (7947)	8.6 (2450)	11.6 (3318)	11.7 (3327)	
Child's sex								
Male	50.9 (14604)	51.3	50.3	50.6	51.2	51.0	51.1	0.95
Female	49.1 (14043)	48.7	49.7	49.4	48.8	49.0	48.9	
Birth order								
First births	18.7 (5353)	19.0	15.5	16.2	22.1	24.4	22.1	0.000
2-4 birth order	45.6 (13069)	47.6	41.3	41.8	47.9	55.8	48.3	
Birth order 5+	35.7 (10225)	33.4	43.2	42.0	30.0	19.8	29.5	
Maternal education								
None	46.5 (14418)	44.5	73.7	78.4	7.2	14.9	6.7	0.000
Primary	23.2 (6552)	29.4	16.6	13.3	31.2	28.9	35.7	
Secondary or higher	30.3 (7677)	26.1	9.6	8.4	61.6	56.2	57.6	
Maternal occupation								
Not working	(30.4) 9035	26.8	37.2	42.3	24.3	14.1	21.5	0.000
Professional	(3.7) 959	3.8	1.1	1.1	6.8	8.4	4.8	
Sales	(33.7) 9026	25.3	25.8	34.7	32.8	47.7	33.9	
Manual	(32.2) 9471	44.1	35.9	21.9	36.1	29.8	39.8	
Mother's marital status								
Single	1.7 (506)	(1.4)	0.9	0.1	2.4	1.9	5.9	0.000
Married	96.8 (57378)	(97.0)	97.4	98.7	95.6	97.1	91.7	
Divorced	1.5 (446)	(1.6)	1.7	1.2	2.0	1.0	2.4	
Maternal age								
15-24	24.8 (7249)	26.1	29.9	30.1	16.5	16.3	20.9	0.000
25-34	49.8 (14111)	49.6	45.8	44.4	55.2	57.0	55.2	
35+	25.4 (7287)	24.4	24.3	25.4	28.3	26.7	23.9	
Mother's age at first birth								
<18 years	39.4 (11723)	38.5	55.2	54.1	17.5	17.5	28.5	0.000
18 years or higher	60.6 (16924)	61.5	44.8	45.9	82.5	82.5	71.5	
Religion								
Christianity	43.1 (11738)	55.3	15.3	4.9	95.7	60.8	95.3	0.000
Islam	55.4 (16152)	42.9	83.6	93.9	0.3	38.4	2.7	
Traditional	1.6 (547)	1.8	1.1	1.1	4.0	0.8	1.9	
Wealth index								
Poor	46.0 (14475)	48.5	71.5	65.5	16.2	16.2	23.7	0.000
Middle	19.3 (5609)	25.1	16.3	17.8	25.5	13.5	22.8	
Rich	34.7 (8563)	26.4	12.1	16.7	58.3	70.3	53.5	

4.2 Community-level contextual characteristics by region of residence

Findings further revealed that all the selected community-level characteristics vary significantly between the regions of residence ($p<0.001$). Assessment of the factor – place of residence indicates that Nigeria as a whole had predominantly high proportion of women residing in rural areas (70%). Even, regional differences showed huge variations as 83% of mothers in the North-west were resident in rural areas while 45% each from South-west and South-south were living in rural areas. With respect to ethnic affiliation of mothers, the results indicated that Hausa/Fulani were mainly in the North-west (91%), the Igbos were mainly found in the South-east (97%), the Yorubas were predominant in the South-west (74.4), (with about 10% of them spreading across the Yoruba speaking states of the North-central); and the minority ethnic groups were mostly found in the South-south (89%) and the North-central (76%).

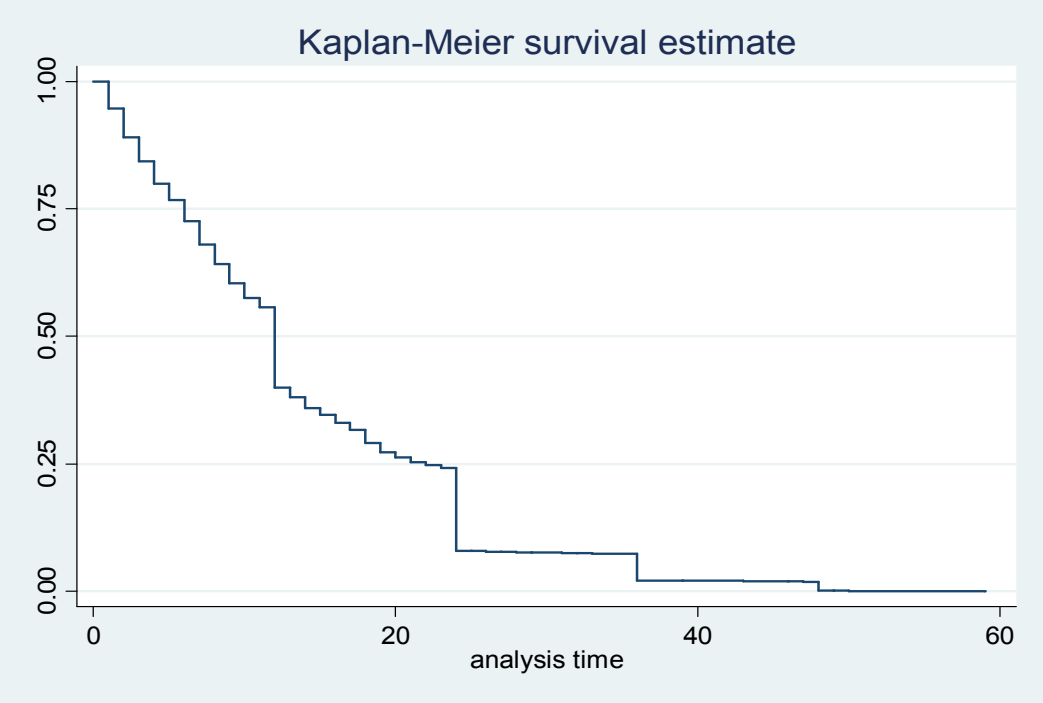
A consideration of community level of education (which is defined in this study as the proportion of women with at least secondary level of education in a community) was found to be very low in the North-east and North-west. But, this was better in the South as mothers were mostly found in communities that had a very high proportion of women with at least secondary education. We found a similar picture in respect of community hospital delivery. The data showed that while the proportion of women who had hospital delivery was low in Nigeria as a whole, very low in some specific regions (e.g. North-east and North-west), regions in the South fared better; as mothers in the South were mainly resident in the communities with a high proportion of mothers who had hospital deliveries.

Also, assessment of the average number of women who had prenatal care by doctor showed a dismal picture in the core Northern regions. For instance, most of the mothers in the North-east and North-west regions lived in communities with a low proportion of mothers who had prenatal

care by a physician. In contrast, a very high proportion of mothers in the South-west lived in communities with a high proportion of mothers who attended prenatal care by a doctor.

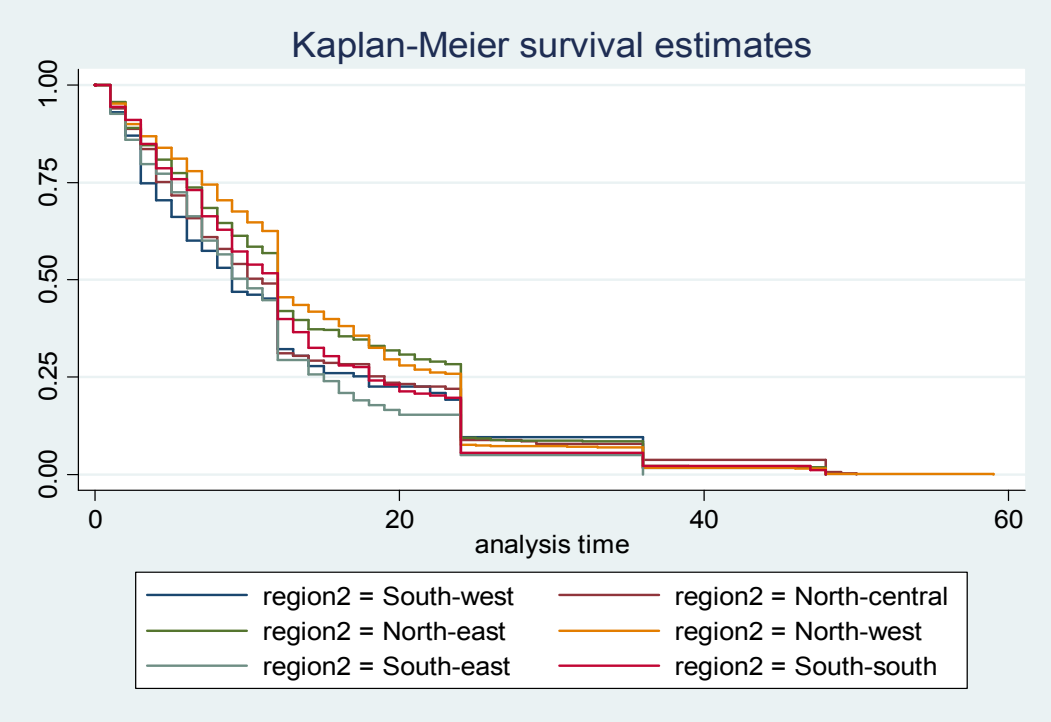
TABLE 2: Percentage distribution of community-level characteristics by geo-political regions

Variables/ Categories	**Nigeria % (n)**	North-Central **%**	North-East **%**	North-West **%**	South-East **%**	South-West **%**	South-South **%**	**p-value**
Place of residence								
Urban	29.8 (7613)	24.5	25.6	17.3	45.2	55.2	27.2	0.000
Rural	70.2 (21034)	75.5	74.4	82.7	54.8	44.8	44.8	
Ethnicity								
Hausa/Fulani/Kanuri	38.3 (10759)	12.8	45.2	91.3	0.4	3.9	0.3	0.000
Igbo	12.4 (2997)	2.0	0.1	0.2	96.9	8.3	9.6	
Yoruba	13.6 (3082)	9.5	0.3	0.2	0.2	74.4	1.6	
Others	35.7 (11643)	75.7	54.4	8.3	2.5	13.4	88.5	
Community level of education								
Low	(11704)	31.4	54.2	70.5	8.9	14.9	2.1	0.000
Middle	(7716)	35.7	22.2	14.3	43.5	33.1	39.1	
High	(9227)	32.9	23.6	15.2	47.6	52.0	58.9	
Community hospital delivery								
Low	41.1 (12714)	27.7	63.6	73.7	5.6	4.8	20.0	0.000
Middle	29.6 (8326)	31.3	22.4	21.2	36.9	32.6	47.5	
High	29.4 (7607)	41.0	14.0	5.1	57.5	62.6	32.5	
Community prenatal care by doctor								
Low	43.0 (13141)	29.2	76.1	68.3	24.6	4.9	16.4	0.000
Middle	26.9 (7412)	32.0	16.9	21.5	31.2	22.9	48.4	
High	30.1 (8094)	38.8	7.0	10.2	44.2	72.2	35.2	



Duration of survival since birth (months)

Figure 1: Child survival plot for all children in Nigeria (5 years before the survey), DHS 2008



Duration of survival since birth (months)

Figure 2: Child survival plot for children in Nigeria by region of residence (5 years before the survey), DHS 2008

4.3 Risk factors of childhood mortality – survival analysis

Table 3 presents the results of Cox proportional hazard models specification for under-five mortality (model 1) and infant mortality (model 2). We conducted a separate survival analysis[8] for infancy to understand the extent to which contextual factors (of the community or neighbourhood where children are born) influence survival chances during the first year of life. Our analysis showed that out of a total number of 3201 under –five deaths, 2042 died before their first birthday. Table 3 presents the association between individual-level factors and infant and under-five mortality.

The results in model (Table 3) showed that the risks of deaths were significantly higher for children of birth order five or higher (HR: 1.22; CI: 1.02-1.46) relative to the children who were first born. The risks of death were significantly lower for children whose mothers had secondary or higher education (HR: 0.72, CI: 0.61-0.86) compared with children of mothers with no education. Risks of death were higher for children whose mothers were Muslims (HR: 1.18, CI: 1.04-1.33); and more than twofold higher for children of divorced or widowed mothers (HR: 2.06, CI: 1.26-3.37) compared with children of mothers in the reference groups. Results also revealed that children of mothers whose age at first birth was 18 years or higher were having lower risks of death (HR: 0.87, CI: 0.78-0.96); and children of mothers in rich wealth quintile also had lower risks of death (HR: 0.67, CI: 0.58-0.76) relative to children in the reference categories.

Results from model specification for infant mortality (Model 2, Table 1) indicate a lower risk of death for children of mothers with secondary or higher education (HR: 0.79, CI: 0.62-1.00); children of mothers aged 25 years or higher (HR: 0.79, CI: 0.66-0.97); children of mothers in rich wealth quintile (HR: 0.73, CI: 0.60-0.90); and for children of mothers whose age at first birth was

[8] Result of survival analysis yielding hazard ratios greater than unity means an increased risk of death, while ratios less than unity imply a decreased risk (Omariba et al, 2007).

18 years or higher (HR: 0.89, CI: 0.76-1.03). In contrast, the risks of death were higher for children of birth order five or higher (HR: 1.24, CI: 0.95-1.62); children of divorced or widowed women (HR: 2.09, CI: 1.0-4.37), and children of mothers who were adherents of traditional beliefs (HR: 1.16, CI: 0.74-1.80).

Furthermore, results of model 3 examining relationship between under-five mortality and community-level characteristics are presented in Table 4 (column 2). Findings indicate that the risks of death were significantly higher for children of mothers resident in the North-Central (HR: 1.46 (CI: 1.17-1.82); South-South (HR: 1.25, CI: 0.98-1.60) and almost twofold higher for children of mothers residing in the North-West (HR: 1.63, CI: 1.31-2.07); North-East (HR: 1.69, CI: 1.35-2.16); and South-East (HR: 1.84, CI: 1.44-2.33) compared with children in the South-west. Risks were also higher for children raised in the rural areas (HR: 1.28, CI: 1.12-1.46). In contrast, the risks of death were significantly lower for children whose mothers were resident in communities with high proportion of mothers who had prenatal care by doctor (HR: 0.84, CI: 0.72-0.97) and communities with high proportion of mothers who had hospital delivery (HR: 0.66, CI: 0.55-0.79).

Also, the model examining the relationship between infant mortality and community-level factors (Table 4 Model 4) indicate a significantly higher risk of death for infants in the North-Central (HR: 1.40, CI: 1.03-1.89) and South-East (HR: 1.84, CI: 1.32-2.55). Higher risks of death were also found among infants in the North-east (HR: 1.20, CI: 0.86-1.67) and North-West (HR: 1.32, CI: 0.96-1.82) relative to infants in the South-West. Higher risks of death were also established for infants in the rural areas (HR: 1.22, CI: 1.01-1.47) compared with those in the urban centres. The risks of dying were found to be lower for children of mothers residing in communities with high proportion of mothers attending prenatal care by doctor (HR: 0.82, CI: 0.66-1.02) and a high proportion of mothers who had hospital delivery (HR: 0.67, CI: 0.51-0.86).

Table 3: Hazard ratios and 95% confidence intervals for individual-level characteristics associated with infant and under-five mortality in Nigeria

Variables/categories	Model 1[a]	Model 2[b]
Birth order		
First births	1	1
2-4 birth order	0.98 (0.85-1.13)	0.96 (0.78-1.18)
Birth order 5+	1.22 (1.02-1.46)*	1.24 (0.95-1.62)
Maternal education		
None	1	1
Primary	0.90 (0.79-1.02)	0.87 (0.72-1.05)
Secondary or higher	0.72 (0.61-0.86)*	0.79 (0.62-1.00)
Maternal occupation		
Not working	1	1
Professional	0.96 (0.68-1.36)	1.0 (0.62-1.63)
Sales	1.03 (0.93-1.15)	1.0 (0.84-1.18)
Manual	1.00 (0.89-1.12)	1.09 (0.92-1.29)
Mother's marital status		
Single	1	1
Married	1.09 (0.72-1.66)	1.33 (0.72-2.46)
Divorced/Widowed	2.06 (1.26-3.37)*	2.09 (1.0-4.37)
Maternal age		
15-24	1	1
25-34	0.93 (0.81-1.06)	0.79 (0.66-0.97)*
35+	1.00 (0.84-1.19)	0.79 (0.61-1.03)
Mother's age at first birth		
<18 years	1	1
18 years or higher	0.87 (0.78-0.96)*	0.89 (0.76-1.03)
Religion		
Christianity	1	1
Islam	1.18 (1.04-1.33)*	1.02 (0.85-1.23)
Traditional	0.92 (0.65-1.29)	1.16 (0.74-1.80)
Wealth index		
Poor	1	1
Middle	0.99 (0.88-1.11)	1.07 (0.9-1.26)
Rich	0.67 (0.58-0.76)*	0.73 (0.60-0.90)*

a. *model specification for under-five mortality*

b. *model specification for infant mortality*

**p<0.05*

Table 4: Hazard ratios and 95% confidence intervals for community-level characteristics associated with childhood mortality in Nigeria

Variables/categories	Model 3[a]	Model 4[b]
Region of residence		
South-West	1	1
North-Central	1.46 (1.17-1.82)**	1.40 (1.03-1.89)*
North-West	1.63 (1.31-2.07)***	1.32 (0.96-1.82)
North-East	1.69 (1.35-2.16)***	1.20 (0.86-1.67)
South-East	1.84 (1.44-2.33)***	1.84 (1.32-2.55)**
South-South	1.25 (0.98-1.60)	1.10 (0.78-1.56)
Place of residence		
Urban	1	1
Rural	1.28 (1.12-1.46)*	1.22 (1.01-1.47)*
Community economic status		
Low	1	1
Middle	1.10 (0.98-1.26)	1.03 (0.86-1.23)
High	1.23 (1.09-1.40)**	1.06 (0.88-1.28)
Community level of education		
Low	1	1
Middle	0.97 (0.86-1.11)	0.89 (0.73-1.07)
High	0.96 (0.87-1.15)	0.99 (0.81-1.23)
Community hospital delivery		
Low	1	1
Middle	0.85 (0.75-0.96)*	0.88 (0.73-1.06)
High	0.66 (0.55-0.79)*	0.67 (0.51-0.86)*
Community prenatal care by doctor		
Low	1	1
Middle	0.99 (0.88-1.11)	1.01 (0.84-1.20)
High	0.84 (0.72-0.97)*	0.82 (0.66-1.02)

a. *model specification for under-five mortality*

b. *model specification for infant mortality*

*p<0.05, **p<0.01, ***p<0.001

4.4 Risk factors of under-five morality: a multilevel analysis

First, we fitted null model[9] to determine whether the use of multilevel modelling was necessary in our analysis. The null model (Table 5 column 2) indicated a significant variation in under-five mortality across individual-level (with variance of 0.73) and community-level (with variance of 0.74); thus justifying the use of multilevel models in the analysis. After incorporating only the region of residence into the multilevel models as contained model 1 (Table 5, column 3), findings revealed that children in the North-east and North-west were having almost twofold higher risks of death (HR=1.9, $p<0.05$) compared with their counterparts in the South-western part of the country. Also, higher risks of death were found among children in the South-east (HR=1.7, $p<0.05$) and South-south (OR=1.5, $p<0.05$) relative to children in the South-west

Since the focus of this paper was to examine the extent to which community contextual factors influence regional variation in under-five mortality in Nigeria (as opposed to individual-level attributes), the risk factors of under-five mortality by region were adjusted for, using community contextual factors. After incorporating only contextual factors into the multilevel models (model 2 in Table 5, column 4), risks of death remained significant but slightly plummeted in all regions. For instance, risks of death were 1.4 significantly higher for children of mothers in the North-central and North-east regions ($p<0.05$) compared with the children in South-west. Results from model 2 further revealed that place of residence is a significant predictor of under-five mortality as risks of death were 27% higher for the children in the rural areas relative to their counterparts in urban centres. In contrast, risks of death were lower for children of mothers resident in the community with high proportion of mothers who had hospital delivery (HR: 0.70, CI: 0.61-0.81, $p<0.05$).

[9] Model 0 contains no explanatory variable

Finally, to adjust for the effect of individual-level factors on the relationship between community contextual factors and child survival, we incorporated individual-level variables into the full model (model 3, Table 5). Results showed that the risks of death remained significantly high in all the regions. However, the risks of death across various regions became slightly attenuated compared with the results in model 1 and model 2. Adjusting for the individual-level attributes in model 3, the significant contextual characteristics include: region of residence, place of residence, community economic status and community hospital delivery. Considering the individual-level attributes included in the full model, children of birth order 2-4 had significantly lower risk of death (HR=0.88, CI=0.78-0.99) compared with the children of first births. Also, children of mothers with secondary or higher education had significantly lower risk of death (HR=0.82, CI=0.71-0.95) relative to children of mothers with no education. We also found that children of divorced mothers had more than twofold higher risks of death than children of the unmarried mothers (HR=2.24, CI=1.45-3.32), and the children of mothers aged 25-34 were having lower risks of death (HR=0.86, CI=0.77-0.97) compared with children of younger mothers (aged 15-24).

Table 5: Hazards ratios and confidence intervals for individual- and community-level risk factors of under-5 mortality

Variables Fixed part	Model 0 (Empty model) OR (CI)	Model 1 (region of residence) HR (CI)	Model 2 (community-level variables) HR (CI)	Model 3 (community & individual levels variables HR (CI)
Community-level variables				
Region of residence				
South-West		1	1	1
North-Central		1.46 (1.03-2.08)*	1.28 (1.07-1.51)*	1.18 (0.99-1.41)
North-East		1.93 (1.36-2.72)***	1.42 (1.19-1.70)*	1.29 (1.06-1.56)*
North-West		1.91 (1.35-2.70)***	1.39 (1.16-1.67)*	1.31(1.08-1.60)*
South-East		1.75 (1.22-2.51)**	1.71 (1.41-2.06)**	1.64 (1.34-2.00)*
South-South		1.47 (1.02-2.10)*	1.30 (1.08-1.57)*	1.31 (1.08-1.59)*
Place of residence				
Urban			1	1
Rural			1.27 (1.15-1.41)*	1.15 (1.02-1.29)*
Community economic status				
Poor			1	1
Middle			1.14 (1.02-1.26)*	1.12 (1.01-1.25)*
Rich			1.27 (1.14-1.41)	1.25 (1.12-1.41)*
Community level of education				
Low			1	1
Middle			0.97 (0.87-1.08)	0.99 (0.88-1.11)
High			0.95 (0.84-1.07)	0.97 (0.85-1.12)
Community hospital delivery				
Low			1	1
Middle			0.87 (0.79-0.97)*	0.92 (0.82-1.03)
High			0.70 (0.61-0.81)*	0.78 (0.67-0.91)*
Community prenatal care by doctor				
Low			1	1
Middle			0.99 (0.89-1.09)	1.0 (0.91-1.11)
High			0.91 (0.80-1.03)	0.94 (0.83-1.07)
Individual-level				
Birth order				
First births				1
2-4 birth order				0.88 (0.78-0.98)*
Birth order 5+				1.09 (0.94-1.27)
Maternal education				
None				1

Primary				0.96 (0.86-1.08)
Secondary or higher				0.82 (0.71-0.95)*
Maternal occupation				
Not working				1
Professional				0.98 (0.74-1.29)
Sales				1.09 (0.99-1.20)
Manual				1.06 (0.96-1.17)
Mother's marital status				
Unmarried				1
Married				1.27 (0.91-1.78)
Divorced				2.24 (1.48-3.38)*
Maternal age				
15-24				1
25-34				0.86 (0.77-0.97)*
35+				0.96 (0.82-1.11)
Mother's age at first birth				
<18 years				1
18 years or higher				0.91 (0.84-1.00)*
Religion				
Christianity				1
Islam				0.93 (0.82-1.06)
Traditional				0.81 (0.61-1.07)
Wealth index				
Poor				1
Middle				0.96 (0.86-1.07)
Rich				0.85 (0.74-0.97)*
Random part				
Individual-level				
Variance (SE)	1.121 (0.111)***	0.024 (0.13)**	0.027 (0.066)***	0.018 (0.40)***
Community-level				
Variance (SE)	0.173(0.029)***	0.02 (0.013)**	0.421 (0.825)***	0.051 (0.092)***
Log likelihood	-9877	-9951	-9912	-9595

*p<0.05, **p<0.01, ***p<0.001, SE – standard error

5. Discussions

The objective of this study was to examine the extent to which the contextual factors[10] influence regional variations in under-five mortality in Nigeria. Findings of the study indicate that region of residence is a significant predictor of under-five mortality in Nigeria, thus supporting findings of earlier studies (Antai 2011a, Antai, 2011b, Antai, 2009, Uthman, 2008). In sub-Saharan Africa, social and economic disparities have been largely attributed to differences in regional distributions of social services, health facilities, housing conditions and other essential services (Boco, 2010, Larrea and Kawachi, 2005, Jatrana, 2008). Antai (2011c) had also earlier attributed regional health disparities to differences in the levels of social and economic development across the six geo-political regions of Nigeria and also due to the huge differences in population densities as well as diversities in religious affiliation and political situations. Also widespread disparities in the coverage of immunization programmes had earlier been observed across regions and communities in Nigeria (Antai, 2010).

Findings showed that generally, risks of childhood death were higher in the Northern part of Nigeria compared with the South-western region. Even, after adjusting for the effect of other contextual factors, region of residence remained a significant predictor of under-five mortality across regions in Nigeria. In particular, the rate of under-five mortality in the North-east and North-west regions stood at 222 deaths and 217 deaths per 1000 live births respectively (NPC and ICF macro, 2009). According to descriptive findings in our analysis, North-east[11] and North-west regions are the regions where children were mostly of birth order five or higher, mothers were mostly uneducated, mainly unemployed and poor; were relatively young mothers and majority were younger than 18 years at the birth of first child.

[10] These are characteristics of neighbourhoods or communities where children are raised

[11] Nigeria's North-east states are: Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe and the country's North-west states are: Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara.

Results from model 2 further revealed that place of residence is a significant predictor of under-five mortality in Nigeria as the risks of death were significantly higher for children resident in the rural areas relative to the children in urban centre. This finding is not unexpected and it is a fact reported in previous studies (Antai, 2010; Boco, 2010; Rutstein et al, 2009; Uthman, 2008). That children of parents resident in the rural area had higher risks of death is not an unexpected finding. This is because access to good health care services is largely poor in rural areas. Besides, women in the rural areas are less educated compared with their counterparts in the urban centres, and rural women are likely to be relatively younger at the birth of their first child and they are likely to have inadequate birth-spacing. Adjusting for the individual-level attributes in multilevel analysis slightly reduced the risks of dying for children in all the regions and also for children of mothers resident in rural areas. This shows that individual attributes such as higher maternal education and improved wealth status can lead to reduced under-five mortality even in socially and economically deprived areas like rural settings.

In addition, this study revealed that community hospital delivery remained a significant predictor of under-five mortality after adjusting for other factors. Also, individual-level attributes such as birth order, maternal education and occupation remain important predictors of under-five mortality in Nigeria. Children of mothers who engaged in sales as occupation were found to be significantly at higher risk of death than the children of mothers who had no job. This finding may not be unconnected to the fact that children of mothers who involved in petty trading and other forms of sales activities may not have time to take adequate care of their children like the mothers who are full housewives and who had all the time to take care of their children. We also found that children of divorced mothers had more than twofold higher risk of death than children of the unmarried mothers. The children of mothers aged 25-34 were also less likely to die compared with children of younger mothers, thus lending credence to findings of earlier studies (Antai, 2010; Larrea and Kawach, 2005). The explanation for this finding is simple. Children of mothers

aged 25-34 are likely to be better catered for than the children of younger mothers because younger mothers are generally inexperienced about child rearing, they are mostly uneducated and often marry too early. Wall (1998) cited the challenges facing young mothers as severe anaemia, pregnancy-induced hypertension, obstructed labour, haemorrhage, fistula and even death.

Thus, we have established in this study that contextual factors are important predictors of under-five mortality in Nigeria. These contextual factors include region of residence, place of residence, community economic status and community hospital delivery. North-east and North-west regions where the risk of under-five mortality was highest are also the regions associated with deprived and lower socio-economic position – primary or no education and divorce (Antai, 2011). Also in these regions, mothers are relatively young at first marriage (Wall, 1998), mostly resident in communities with low proportion of mothers having hospital deliveries, relatively young at the birth of first child, practise short birth-spacing and have so many children (Adedini et al., 2011)

These findings have important policy implications. In order to address regional disparities in under-five mortality in Nigeria, it is important to look beyond individual attributes. Contextual determinants must also be addressed. Besides, efforts must be intensified by both central and regional or state governments to address the imbalances in socio-economic development across the six geopolitical zones as well as spatial inequality in social development across communities within the various regions.

This study has its limitation. Other important contextual factors (such as cultural practices and customs) could not be addressed in this study. Being an analysis of a secondary dataset, such important factors were unavailable in the DHS dataset. As a result, further studies on the contextual factors associated with under-five mortality are needed in Nigeria. Nonetheless, use of DHS dataset has its own strength. DHS datasets are nationally representative and one could easily generalize findings across the whole country. Also, international comparisons of results are possible, because, DHS surveys adopt similar instruments across countries.

6. Conclusion

This study has demonstrated the importance of the contextual characteristics of communities or neighbourhoods in explaining the regional variations in the risk of under-five mortality in Nigeria. The results of this study stress the need to look beyond the influence of individual-level factors in addressing the problem of under-five mortality in the country. In order to realize MDG4 in Nigeria, attention also needs to be focused on community-level interventions aimed at improving child survival in the country's socially and economically disadvantaged areas.

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