Individual- and Contextual-Level Determinants of Social Inequities in Under-Five Mortality in Nigeria: Differentials by Religious Affiliation of the Mother

Diddy Antai, Karolinska Institute, Department of Public Health Sciences, Division of Social Medicine (Unit of Epidemiology), Stockholm, Sweden
Division of Global Health & Inequalities, The Angels Trust – Nigeria, Abuja, Nigeria

Justina Antai, Division of Communication for Development and Gender Studies, The Angels Trust, Ymergatan 3, Box 372, SE-101 27 Stockholm, Sweden.

Diddy E. Antai, MD, MPH, MMSc, Karolinska Institute, Department of Public Health Sciences, Division of Social Medicine (Unit of Epidemiology), SE 171 76, Stockholm, Sweden,
Tel: +46-7373896, Fax: +46 (0)8 33 46 93, Email: Diddy.Antai@ki.se

Abstract
In sub-Saharan Africa, social factors such as religion have been linked with significant child morbidity and mortality. In religiously multi-denominational societies, one dominant religious group tends to subject the other groups to some form of economic, social or political discrimination, resulting in inequities in child survival. This study assessed the influence of individual- and community-level indicators underlying the association between religion and under-five mortality using multilevel logistic regression modelling. There is a significant association between religion and under-five mortality, which is considerably attenuated by sequentially adjusting for other risk factors. The effect of religion on under-five mortality is influenced by contextual-level characteristics of the community. Traditional religion is associated with under-five mortality, which is attributed to individual- and community-level indicators. Policy measures aimed at tackling child health inequities due to social factors such as religion need to consider the significance of the context in which mothers in different communities live, when healthcare interventions are being planned.

Background

Focus on child survival in developing countries has shifted from individual-level factors to wider social determinants – public health systems, gender-role, and maternal and child healthcare services within communities (Mosley and Chen 2003; Andes 1992; Braithwaite et al. 1989). Often, structural socio-economic stratification, women's empowerment, access to healthcare services and cultural

practices either facilitate or constrain the accessibility of health-promoting resources to individuals within a community. Viewing under-five mortality within the religious context involves examining possible structural forces influencing mortality at the community level. Since many public health interventions are context-specific, documenting underlying contextual determinants of under-five mortality among religious groups may improve the impact of health interventions aimed at specific populations (Victora et al. 2005).

Social factors have been identified at the root of many of the gross inequalities in health within and between countries (World Health Organization [WHO 2004]). Social inequities in child health (i.e., differences in child health status that are directly or indirectly generated by social, economic and environmental factors, and structurally influenced lifestyles) are systematic, socially produced, modifiable and unfair (Braveman and Gruskin 2003; Whitehead and Dahlgren 2006) and should therefore be amenable to changes in policy.

In sub-Saharan Africa, besides socio-economic determinants of health, social factors such as religion, ethnicity and gender have been shown to influence child health (Van Poppel et al. 2003). For instance, societies that are religiously multi-denominational tend to be divided along religious lines, with one dominant religious group subjecting the other groups to some form of economic, social or political discrimination (Van Poppel et al. 2003). Recent studies have reported the manipulation of religious symbols and beliefs in the struggles for political power and influence in Africa (Nzeh 2002). In contemporary African countries, religious or political elites seeking political influence have used religion to gain legitimacy and to attract sympathy and support from those of similar faith (Antai et al. 2008; Nzeh 2002). This has had serious ramifications for child health and survival in Nigeria and other developing countries (Antai et al. 2008).

Introduction

Nigeria's population is about 50% Muslim (mostly Sunni) and 40% Christian; about 10% practices traditional indigenous or other religions (National Population Commission [NPC] 2004). There is a strong correlation between religious, ethnic and regional diversity in Nigeria, with the northern regions being predominantly Muslim and dominated by the large Hausa and Fulani ethnic groups. The southern regions are predominantly Christian and dominated by Igbo, Yoruba and other ethnic groups (International Religious Freedom Report [IRFR] 2003). Muslims and Christians in the north and south of Nigeria commonly adhere to traditional indigenous practices (Geissler 1998). However, the existence of multiple doctrinally diverse religions within a single society (i.e., religious pluralism) and different religious faiths within a single society have been reported to result in the somewhat weakened influence of a particular religion within that society (Haralambos et al. 2000). This may prevent the dominance of the religious values of a particular religion on those of the entire community (Haralambos et al. 2000).

The healthcare system in Nigeria is multidimensional and comprised mainly of orthodox medicine and traditional healing (Odebiyi and Pearce 1987; Okunola 1993). Traditional indigenous religions typically involve spiritual beliefs and deities that primarily serve to provide supernatural guidance in everyday life; for example, spiritual entities are believed to protect adherents from sickness and control supernatural forces of healing (Cohen 2006). It is common for people to adhere to a mixture of traditional and Christian/Islamic faiths and healing practices, sometimes in succession, but often traditional health services perform complementary functions, especially to orthodox medicine (Idehen 2007; Simpson 1994). Gains in the utilization of modern healthcare facilities and Western-style education by Christians in southern Nigeria could be traced back to southern Nigerians' early exposure to Christianity. Islam was introduced into the northern parts of Nigeria during the tenth century by Muslim merchants from North Africa (Laremont and Gregorian 2006).

2003). With the European military conquest of southern Nigeria in the seventeenth century, European missionaries began introducing Christianity primarily into southern Nigeria and, to a lesser extent, into many parts of northern Nigeria (Balewa 1994).

The relationship between religion and mortality is an established one, and several studies have

shown the association between religion and child mortality. This association is attributed in part to the underlying differential use of maternal and child health services (Addai 2000; Akoto 1990; Bairagi et al. 1999; Teeraworn 2002), socio-economic position (Gyimah 2006) and institutional structure (Jones 2004). Religion is also a predictor of child immunization status (Antai 2009; Nath et al. 2007), which increases the risk of child mortality. Recent demographic studies focused on the role of religion in child mortality in sub-Saharan Africa and showed that mother's religious affiliation was significantly associated with increased under-five mortality, attributed to use of maternal and child health services (Antai et al. 2008) and differential access to social and human capital rather than religion per se (Gyimah 2007). These studies, however, did not assess the hierarchical nature of the Demographic and Health Survey (DHS) data and therefore the fact that children of the same mother are more alike than children selected at random from the population.

Conceptual Framework – Effect of Religion on Health

Previous studies have sought to explain the effects of religion on health by tracing its pathways and mechanisms of influence (Goldscheider 1971). Two hypotheses have been used to explain this influence – the "characteristics hypothesis" and the "particularized theology hypothesis." The characteristics hypothesis suggests that religious affiliation has little or no independent influence on health but, rather, that the demographic, social and economic composition of religious groups largely accounts for observed differences in child survival between the groups (Goldscheider 1971; Goldscheider and Mosher 1988). The particularized hypothesis on the other hand posits that differences in child survival within religious groups are a result of specific doctrines of a religion, that is, the presence or absence of specific religious tenets directly related to child health, and beliefs and values of the different religious groups that influence child health and survival (Goldscheider 1971; Goldscheider and Mosher 1988). The lifestyles that a religious doctrine may prescribe or proscribe, coupled with the regulation of health-related behaviours of its followers, may lead to the adoption of health-damaging or health-promoting behaviours that consequently affect child health and survival. This present study focuses on the influence of contextual factors on the risk of under-five mortality differentials among the religious groups in Nigeria, and thereby goes beyond attempting to prove or disprove the characteristics or particularized theology hypotheses already assessed in previous studies (Antai et al. 2008; Gyimah 2007). Our study therefore uses multilevel logistic regression modelling to examine the effect of individual- and community-level factors on under-five mortality among the religious groups in Nigeria. The objectives of this study were to (1) assess whether under-five mortality varies across contexts, (2) investigate the individual-level relationship between religion and under-five mortality by sequentially controlling for other risk factors, and (3) determine whether contextual explanatory variables account for religious variation in under-five mortality among contexts.

Methods

Definition

Mother's religious affiliation is defined as the identification with a particular religious group (Koenig et al. 2001). Mother's religious affiliation was used in this study due to the absence of multiple measures of religion in the 2003 Nigeria DHS dataset.

Data and Methods

Data from the 2003 Nigeria DHS was used for this study, with a probability sample collected using a stratified two-stage cluster sampling procedure according to the list of enumeration areas developed from the 1991 Population Census sampling frame. Initial sampling involved the selection of 365 clusters (primary sampling units) with a probability proportional to the size (size being the number of households in the cluster). Subsequent sampling involved the systematic selection of households from the chosen clusters, resulting in a nationally representative probability sample of 7864 households. From these households, data were collected by face-to-face interviews from 3725 women aged

15 to 49 years who contributed a total of 6029 live-born children within 5 years before the survey. Information about the aggregate childbearing experience of respondents was also collected, such as the number of sons and daughters who live with the mother, the number who live elsewhere and the number who had died. Information was collected on sex, month and year of birth, survivorship status and current age or, if the child had died, age at death for each of the births. These birth history data were then used to directly estimate the under-five mortality. Further description of the survey methodology is available elsewhere (NPC 2004).

Measures

The outcome variable is under-five death, defined as a live-born child dying between birth and the fifth birthday.

Exposures

Ethnicity

Mother's religious affiliation was indicated by the question, "What is your religion?" in the Nigeria DHS questionnaire. It was categorized as Christian, Muslim, Traditional religion/others.

Individual-Level Risk Factors

Four other child- and mother-level variables of interest were assessed: (a) birth order and interval between births, created by merging "birth order" and "preceding birth interval" and classified as first birth, birth order 2–4 with short birth interval (<24 months), birth order 2–4 with medium birth interval (24–47 months), birth order 2–4 with long birth interval (48+ months), birth order 5+ with short birth interval (<24 months), birth order 5+ with medium birth interval (24–47 months) and birth order 5+ with long birth interval (48 months); (b) mother's age, grouped as 15–18, 19–23, 24–28, 29–33, and 34 years and older; (c) mothers' education, categorized as no education, primary, and secondary or higher education; and (d) place of residence, categorized as rural and urban. Only variables that were significantly associated with mothers' religious affiliation in the bivariate analyses were entered into the multilevel regression models.

Community-Level Risk Factors

Four community-level variables were assessed: (a) community mother's education, defined as the percentage of mothers with secondary or higher education in the primary sampling unit (PSU) and categorized as low and high; (b) community hospital delivery, defined as the percentage of mothers who delivered their child in the hospital and categorized as low, middle and high; (c) community child immunization, defined as the percentage of children who received the eight vaccines in the Expanded Program on Immunization (EPI) schedule recommended by the WHO, including Bacillus Calmette-Guérin (BCG) at birth, three doses of diphtheria, pertussis and tetanus (DPT) vaccine at 6, 10 and 14 weeks of age, three doses of oral polio vaccine (OPV) at birth and at 6, 10 and 14 weeks of age, and one dose of measles vaccine at 9 months of age; this was categorized as low, middle and high; and (d) region of residence, categorized according to the six geo-political zones in Nigeria as North Central, North East, North West, South East, South South and South West.

Community-level variables were assessed at the level of the PSUs (n = 365). PSUs or clusters are administratively defined areas used as proxies for "neighbourhoods" or "communities" (Diez-Roux 2001; Pearl et al. 2001) and are often relevant when the hypothesis involves policies, when features of the social and physical environment are hypothesized to be of significance. PSUs are small and designed to be fairly homogenous units with regard to population socio-demographic characteristics, economic status and living conditions. They consist of one or more enumeration areas (EAs), the smallest geographic units for which census data are available in Nigeria. Each cluster was made up of a minimum of 50 households; in the case of less than 50 households, a contiguous EA was added (NPC 2004). Table 1 shows a description of the individual- and contextual-level variables used in the multilevel logistic regression models.

Table 1. Definition of individual- and contextual-level variables used in the multilevel logistic regression models

Variables	Definition of measures
Outcome	
The risk of under-five mortality (0–59 months)	The probability of dying between birth and the fifth birthday of a child born within 5 years prior to the survey
Exposures	
Individual-level variables	
Religion	Mother's religious affiliation [Christian, Islam, Traditional/Others]
Birth order and birth interval	Birth order and birth interval of the child [first births, 2–4 months birth order & <24 months birth interval, 2–4 birth order & 24-47 months birth interval, 2–4 birth order & 48+ months birth interval, 5+ birth order & <24 months birth interval, 5+ birth order & 24-47 months birth interval, 5+ birth order & 48+ months birth interval]
Mother's age	Mother's age at birth of the child (in years) [15–18, 19–23, 24–28, 29–33, 34+]
Mother's education	Mother's highest level of education [No education, primary education, secondary or higher education]
Place of residence	Place of residence [rural, urban]
Community-level variables	
Community mother's education	Percentage of mothers with secondary or higher education in the PSU [low, high]
Community child immunization	Percentage of children who received full immunization in the PSU [low, middle, high]
Community hospital delivery	Percentage of mothers who delivered in hospital in the PSU [low, middle, high]
Region of residence	Region of residence [North Central, North East, North West, South East, South South, South West]

Note. PSU = primary sampling unit.

Ethical Consideration

The survey procedure and instruments for the 2003 Nigeria DHS are ethically approved by the Ethics Committee of the Opinion Research Corporation (ORC) Macro International, Incorporated, Calverton, USA, and by the National Ethics Committee in the Federal Ministry of Health, Nigeria. Informed consent was obtained from all participants prior to participation in the survey, and information was collected confidentially. This study is based on analysis of secondary data with all participant identifiers removed. Ethical permission for use of the data in the present study was obtained from ORC Macro Inc.

Analysis

We estimated the proportions of the total sample using the Stata 10 software package (StataCorp 2001) and used Pearson's chi-square test to estimate the differences in proportions of individual- and community-level characteristics by religious affiliation of the mother. We used normalized sample weights provided in the DHS data for all analyses to adjust for non-response and enable the extrapolation of findings to the general population.

Multilevel Logistic Regression Modelling

We used a three-level multilevel logistic regression model to account for the hierarchical nature of

the DHS data, with children (level 1) nested within mothers (level 2), who are in turn nested within communities (level 3) (Snijders and Bosker 1999). We fitted five models into the analysis. Model 0 (null model) contained no explanatory variable and focused on decomposing the total variance (VTotal) into its individual (VI) and community (VC) components. Model 1 included religion as the only explanatory variable, and Model 2 added a child-level variable (birth order and birth interval). Model 3 further included the mother-level variables (mother's age, mother's education and place of residence). Model 4 added community-level variables (community mother's education, community child immunization, community hospital delivery and region of residence).

The three-level multilevel model equation is written as follows:

$$\text{log it}\,(\pi_{ijk}) = \log\left(\frac{\pi_{ijk}}{1-\pi_{ijk}}\right) = \beta_0 + X_{ijk} + u_{0jk} + v_{0k}$$

where π_{ijk} is the probability of dying for the ith child of the jth mother in the kth community, e_{ijk} is a child-level error term distributed as Bernoulli constant, X_{ijk} is a vector of covariates corresponding to the ith child of the jth mother in the kth community including mother's religious affiliation and educational background, β_0 is a vector of unknown parameters, u_{0jk} is the random effect at the mother level and v_{0k} is the random effect at the community level. The intercept or average probability of dying is assumed to vary randomly across mothers and communities. The multilevel analysis was performed using the MLwiN software package 2.0.2 (Center for Multilevel Modelling 2000). Model estimation was carried out using first order Penalized Quasi-Likelihood (PQL) procedures, which correct for downward bias in standard error, and overstatement of the significance of the exposure variables associated with clustering of observations within primary sampling units (Rashbash et al. 2000).

Measures of association (fixed effects) were expressed as odds ratios (OR) and 95% confidence interval (95% CI). Measures of variation (random effects) were expressed as variance partition coefficient (VPC) and percentage change in variance (PCV). The VPC is a measure of the extent to which members of a family are more like each other than they are like individuals from other families. Large VPC values reflect the importance of mother-level factors in understanding the risk of under-five mortality, while VPC values close to zero show that mother-level factors exert only a small influence on the risk of under-five mortality. Precision of the model was assessed by standard error (SE), and parameters were tested using the Wald statistic, that is, the ratio of the estimated variance to its standard error (Larsen and Merlo 2005). *P*-values were also calculated for each variable entered into the model. Bayesian deviance information criterion (DIC) was used to estimate the goodness of fit of consecutive models by applying Markov Chain Monte Carlo (MCMC) techniques (Browne 2003). The DIC decreases as significant effects (both random and fixed) are added to the model, hence a smaller DIC indicates an improvement of a multivariable model on the previous model (Browne 2003; Spiegelhalter et al. 2002).

Results

Demographic and Socio-Economic Characteristics of Children in Each Religious Group (Table 2)

The children were most commonly of 2–4 birth order and 24–47 months birth interval, born to mothers 24–28 years of age with no education and living in rural areas. Individual-level characteristics disaggregated by religion showed that among Christian mothers, children of 2–4 birth order and 24–47 months birth interval were the most common. The Christian mothers were mostly 24–28 years of age at childbirth, had secondary or higher education and resided in rural areas.

Muslim children were mostly of 2–4 birth order and 24–47 months birth interval, and Muslim mothers were mostly 24–28 years of age at child birth, without education, and rural residents. Children of Traditionalist mothers were most commonly of 5+ birth order and 24–47 months birth interval, while Traditionalist mothers were mostly 34 years or older at childbirth, uneducated and

rural residents. There were statistically significant differences in the characteristics of the children and mothers among the different religious groups, except for place of residence.

Table 2. Proportion of children in each religious group by demographic and socio-economic characteristics

Characteristics	Total *N* (%)	Religious affiliation of mother			
		Christianity *n* (%)	Islam *n* (%)	Traditional/ other *n* (%)	*P*-value
Religion	6029 (100)	2307 (38)	3598 (60)	124 (2)	
Birth order/birth interval					.000
First birth (order 1)	1200 (20)	507 (22)	681 (19)	12 (10)	
Order 2–4 & <24 months	642 (11)	255 (11)	376 (11)	11 (9)	
Order 2–4 & 24–47 months	1563 (26)	625 (27)	915 (25)	23 (19)	
Order 2–4 & 48+ months	416 (7)	193 (8)	213 (6)	10 (8)	
Order 5+ & <24 months	484 (8)	126 (6)	340 (9)	18 (14)	
Order 5+ & 24–47 months	1287 (21)	433 (19)	822 (23)	32 (26)	
Order 5+ & 48+ months	437 (7)	168 (7)	251 (7)	18 (14)	
Mother's age at child birth					.000
15–18	264 (4)	44 (2)	219 (6)	1 (1)	
19–23	1147 (19)	367 (16)	761 (21)	19 (15)	
24–28	1807 (30)	693 (30)	1092 (30)	22 (18)	
29–33	1263 (21)	562 (24)	677 (19)	24 (19)	
34+	1548 (26)	641 (28)	849 (24)	58 (47)	
Mother's education					.000
No education	3033 (50)	408 (18)	2538 (70)	87 (70)	
Primary	1473 (25)	846 (37)	595 (17)	32 (26)	
Secondary or higher	1523 (25)	1053 (45)	465 (13)	5 (4)	
Place of residence					.453
Rural	3911 (65)	1497 (65)	2327 (65)	87 (70)	
Urban	2118 (35)	810 (35)	1271 (35)	37 (30)	

Note. Birth order and birth interval were created by merging "birth order" and "preceding birth interval" and were classified as follows: first births, order 2–4 (<24 months) denotes child is 2nd to 4th in birth order and was born less than 24 months before the next birth; order 2–4 & 24–47 months denotes child is 2nd to 4th in birth order and was born between 24 and 24 months before the next birth; order 2–4 & 48+ months denotes child is 2nd to 4th in birth order and was born 48 months or more before the next birth; order 5+ & <24 months denotes child is 5th or more in birth order and was born less than 24 months before the next birth; order 5+ & 24–47 months denotes child is 5th or more in birth order and was born between 24 and 24 months before the next birth; order 5+ & 48+ months denotes child is 5th or more in birth order and was born 48 months or more before the next birth.

Multilevel Logistic Regression Analysis of Under-Five Mortality and Religious Affiliation of the Mother (Table 3)

Table 3 presents the multilevel models that sequentially elucidate the relationship between religion and under-five mortality. The bottom of the table shows that each additional model represents a significant improvement in fit over the preceding model.

Objective 1: To Assess Whether Under-Five Mortality Varies across Contexts

The null model indicates that there is significant variation in under-five mortality across contexts, that is, by mothers ($\tau = 0.316$, $p = .020$) and communities ($\tau = 0.253$, $p = .001$). The intra-mother and intra-community correlations, indicated by the variance partition coefficient (VPC), are 7% and 8%, respectively. These values are relatively small, indicating that a large proportion of the variation in under-five mortality occurs at the individual level.

Objective 2: To Elucidate the Individual-Level Relationship between Ethnicity and Child Mortality by Sequentially Controlling for Other Explanatory Factors

Model 1 added random slopes for religion, which was then allowed to vary over contexts (i.e., assigned a random error term) in order to investigate whether its effect is different among contexts. Children of Traditionalist mothers had a twofold increased risk of dying (OR=2.23 [95% CI 1.37, 3.62]) compared with children of Christian mothers, and children of Muslim mothers had a 35% higher risk of dying (OR=1.35 [95% CI 1.13, 1.61]) than children of Christian mothers. The variation in under-five mortality in Model 1 remained significant across mothers ($\tau = 0.270$, $p = .043$) and communities ($\tau = 0.216$, $p = .002$). Compared to the null model, the increased intra-mother correlation of 14.6 and the decreased intra-community correlation of 5.7 indicate that controlling for religion slightly increases the proportion of variance in under-five mortality existing between mothers but decreases that existing between communities, respectively. As indicated by the proportional change in variance (PCV), religion explained 7.1% and 14.6% of the variance in the odds of under-five mortality across mothers and communities respectively, indicating that part of the clustering of child mortality within areas is due to the composition of the population of the areas by religion. This is a composition effect.

Model 2 adjusted for birth order/birth interval. The risks of dying remained significant though slightly reduced for children of Traditionalist (OR=2.16 [95% CI 1.34, 3.50]) and Muslim (OR=1.29 [95% CI 1.08, 1.54]) mothers compared with children of Christian mothers. Children of high birth order/interval (5+ birth order and <24 months birth interval) had a twofold increased risk of dying (OR=2.55 [95% CI 1.96, 3.33]), and first births had a 36% increased risk of dying (OR=1.36 [95% CI 1.08, 1.71]) compared with children of Christian mothers.

Compared to Model 1, significant variation in under-five mortality persists across communities ($\tau = 0.204$, $p = .002$), while mother-level variation became non-significant. The intra-community correlation remained basically unchanged at 5.6%, while the intra-mother correlation became smaller than in Model 1 (3.4%), indicating that birth order/birth interval accounts for some of the community-level variation in under-five mortality. The PCV in this model indicates that 61.4% and 19.4% of the variance in the odds of under-five mortality across mothers and communities respectively was explained by birth order/birth interval. This is also an indication that the composition of the households by birth order/interval of the children is responsible for part of the clustering of child mortality within mothers.

Model 3 added mother's age at birth, mother's education and place of residence. The risks of dying for children of Traditionalist mothers remained persistently higher (OR=1.73 [95% CI 1.07, 2.79]) than that of children of Christian mothers. The risk of dying for first births was attenuated (OR =1.44 [95% CI 1.21, 1.99]) and the risk for children of high birth order/interval (5+ birth order and short birth interval of <24 months) remained unchanged at twofold (OR=2.11 [95% CI 1.56, 2.84]) the risk for children of Christian mothers. Children of high birth order/interval (5+ birth order and high birth interval of 48+ months) had a lower risk of dying than children of the

Table 3. Individual- and community-level contextual factors associated with under-five mortality by mother's religious affiliation in Nigeria from multivariable multilevel logistic regression models

Variables	Model 0[a] (Null model)	Model 1[b] (Religion)	Model 2[c] (Child-level variables)	Model 3[d] (Mother-level variables)	Model 4[e] (Community-level variables)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Fixed effects					
Individual characteristics					
Religion					
Traditional/other		2.23 (1.37, 3.62)**	2.16 (1.34, 3.50)**	1.73 (1.07, 2.79)*	1.72 (1.06, 2.79)*
Islam		1.35 (1.13, 1.61)**	1.29 (1.08, 1.54)**	1.08 (0.88, 1.33)	0.92 (0.70, 1.19)
Christian		1	1	1	1
Birth order/birth interval					
First birth (order 1)			1.36 (1.08, 1.71)**	1.44 (1.21, 1.99)**	1.59 (1.24, 2.05)***
Order 2–4 & <24 months			1.17 (0.88, 1.55)	1.18 (0.89, 1.57)	1.17 (0.89, 1.56)
2–4 & 24-47 months			1	1	1
Order 2–4 & 48+ months			0.73 (0.49, 1.07)	0.72 (0.49, 1.07)	0.74 (0.49, 1.09)
Order 5+ & <24 months			2.55 (1.96, 3.33)***	2.11 (1.56, 2.84)***	1.96 (1.45, 2.64)***
Order 5+ & 24–47mths			1.25 (0.96, 1.64)	1.04 (0.79, 1.36)	0.97 (0.74, 1.28)
Order 5+ & 48+ months			0.75 (0.52, 1.09)	0.59 (0.39, 0.88)*	0.57 (0.38, 0.85)**
Mother's age					
15–18				0.76 (0.50, 1.16)	0.69 (0.45, 1.05)
19–23				0.99 (0.78, 1.26)	0.95 (0.74, 1.21)
24–28				1	1
29–33				1.00 (0.79, 1.28)	1.02 (0.79, 1.30)
≥34				1.28 (0.99, 1.66)	1.34 (1.04, 1.74)*
Mother's education					
No education				1.96 (1.52, 2.54)***	1.71 (1.28, 2.28)***
Primary				1.72 (1.34, 2.22)***	1.68 (1.28, 2.21)***
Secondary or higher				1	1
Place or residence					
Rural				1.46 (1.21, 1.76)***	1.25 (1.02, 1.53)*
Urban				1	1
Community characteristics					
Community mother's education[x]					

Table 3. Continued

Low					0.98 (0.74, 1.31)
High					1
Community hospital delivery					
Low					1.23 (0.99, 1.54)
Middle					1
High					0.66 (0.49, 0.89)**
Community child immunization[†]					
Low					1.13 (0.91, 1.39)
Middle					1
High					1.01 (0.77, 1.31)
Region of residence					
North Central					1
North East					1.26 (0.94, 1.70)
North West					1.18 (0.87, 1.59)
South East					1.10 (0.74, 1.64)
South South					1.43 (0.99, 2.08)
South West					0.95 (0.64, 1.41)
Random effects	**Null**	**Religion**	**Child-level**	**Mother-level**	**Community-level**
Community-level					
Variance (SE)	0.253 (0.074)**	0.216 (0.069)*	0.204 (0.067)*	0.145 (0.061)*	0.114 (0.057)*
VPC (%)	6.6	5.7	5.6	4.1	3.2
Explained variation (PCV) (%)	Reference	14.6	19.4	42.7	54.9
Mother-level					
Variance (SE)	0.316 (0.137)*	0.270 (0.134)*	0.122 (0.127)	0.107 (0.123)	0.114 (0.121)
VPC (%)	8.2	14.6	3.4	3.0	3.2
Explained variation (PCV) (%)	Reference	7.1	61.4	5.9	63.9
Model fit statistics					
DIC	4808	4800	4746	4719	4702

Note. [a]Model 0 contained no variables; [b]Model 1 added religion; [c]Model 2 adjusted for birth order/birth interval; [d]Model 3 additionally adjusted for mother's age at child birth, and mother's education; [e]Model 4 additionally adjusted for region of residence, community mother's education, community hospital delivery and community child immunization.

[¤] Percentage of mothers that delivered in a hospital facility in the sampling unit.

[¥] Percentage of mothers with secondary or higher education in the primary sampling unit.

[†] Percentage of children that were fully immunized in the sampling unit.

*$p<$ .05; **$p<$ .01; ***$p<$ .001.

VPC = variance partition coefficient; DIC = deviance information criterion; SE = standard error: OR = odds ratio; CI = confidence interval.

Source: 2003 Nigeria Demographic and Health Survey.

reference group (2–4 birth order and medium birth interval of 24–47 months). Children of mothers with no education and with primary education had a 96% (OR=1.96 [95% CI 1.52, 2.54]) and 72% (OR=1.72 [95% CI 1.34, 2.22]) higher risk of dying respectively, compared with children of the reference group (mothers with secondary or higher education). Children of mothers residing in rural areas had a 46% higher risk of dying (OR=1.46 [95% CI 1.21, 1.76]) compared with children of mothers in urban areas.

In comparison to Model 2, the variation in under-five mortality persisted across communities and remained significant (τ = 0.145, p = .018). The intra-community correlation became smaller than in Model 2 (4.1%), indicating that mother's education and place of residence accounted for some of the community-level variation in under-five mortality. Intra-mother correlation remained basically unchanged at 3.4%. The PCV in Model 3 indicates that 42.7% of the variance in the odds of under-five mortality across communities, and 5.9% of the variance in the odds of under-five mortality across mothers, were explained by characteristics at the mother-level. This is another composition effect of mother's characteristics within communities.

Objective 3: Determine Whether Contextual-Level Variables Account for Variation in Under-Five Mortality among the Religious Groups

Model 4 added the effects for the four contextual-level variables for the sampling area: community mother's education, community hospital delivery, community child immunization and region of residence. The risk of dying for children of Traditionalist mothers remained significant and unchanged (OR=1.72 [95% CI 1.06, 2.79]). The risk of dying for first births was attenuated (OR=1.59 [95% CI 1.24, 2.05]), and the risk was reduced for children of 5+ birth order and short birth interval of <24 months (OR=1.96 [95% CI 1.45, 2.64]). The risk for children of 5+ birth order and long birth interval of 48+ months remained unchanged, and lower (OR=0.57 [95% CI 0.38, 0.85]) than that of the reference group. Children of mothers 34 years or older now had a 34% higher risk of dying (OR=1.34 [95% CI 1.04, 1.74]) than children of mothers 24–28 years of age at childbirth, whereas this had been insignificant in the previous model. The risks were slightly reduced for children of mothers with no education (OR=1.71 [95% CI 1.28, 2.28]) and primary education (OR=1.68 [95% CI 1.28, 2.21]) compared with children of mothers with secondary or higher education. The risk was slightly reduced for children of mothers residing in rural areas (OR=1.25 [95% CI 1.02, 1.53]) compared with children of mothers in urban areas.

Community hospital delivery was significantly associated with under-five mortality across religious groups. Children of mothers residing in communities with high a percentage of hospital delivery had a 66% lower risk of dying (OR=0.66 [95% CI 0.49, 0.89]) compared with children of mothers in communities with a low percentage of mothers who delivered in hospital.

In comparison to Model 3, there was a persistent significant variation in under-five mortality across communities (τ = 0.114, p = .045). The intra-community correlation reduced further compared to that in Model 3 (3.2%), while the intra-mother correlation remained basically unchanged at 3.0%, signifying that differences in the PSUs regarding the average under-five mortality are partly due to differences in distribution of religious groups across PSUs. The PCV in Model 4 showed 54.9% of the variance in the odds of under-five mortality across communities and 3.2% of across mothers, which were both mainly composition effects. Mother-level variance was largely explained by child-level variables. Community-level variance was mainly explained by religion and other mother-level variables.

As indicated by the smaller values of deviance information criterion (DIC) with each successive model, our model fits the data very well. This implies that the individual- and community-level variables in our model increased the ability of the multivariable multilevel logistic model to explain variations in the odds of under-five mortality by religious affiliation of the mother.

Discussion

In summary, our findings indicate that

1. There is significant variation in under-five mortality across contexts;
2. There is an association between religion and under-five mortality, and this relationship is considerably attenuated by sequentially adjusting for other risk factors, especially birth order/birth interval, mother's education and place of residence;
3. Under-five mortality indeed varies significantly across communities;
4. Contextual-level factors account for religious variation in under-five mortality over and above the individual characteristics of the mother or child;
5. The effect of religion on under-five mortality at the individual-level is significantly random across communities; and
6. Characteristics of the community (community hospital delivery) influence the effect of religion on under-five mortality, in that children of mothers residing in communities with an overall high percentage of mothers who delivered in hospital are at lower risk of dying compared with children of mothers in communities with a low percentage of hospital delivery.

Estimated proportions indicated significant differentials in under-five mortality among the different religious groups in birth order/birth interval, mother's age at child birth and mother's education. Multilevel logistic regression analysis controlled for individual- and contextual-level factors, and showed that children of Traditional/other mothers have a higher risk of dying before their fifth birthday compared to children of Christian mothers. This could be attributed, at the individual level, to the religious differences in birth order and birth interval, mother's age at childbirth and mother's educational level, which is in agreement with a recent study (Antai et al. 2008). First births, and high order/interval births (i.e., 5+ birth order and short birth interval of <24 months; and 5+ birth order and long birth interval of 48+ months) were found to be significantly associated with an increased risk of under-five mortality. This is in agreement with previous studies that show an inverse relationship between first births, births with short intervals and child mortality rates (Lawoyin 2001; Madise and Diamond 1995; Manda 1999). Child mortality has been shown to be associated with high birth order and short interval births, given that rapid succession of births may deplete the reproductive and nutritional resources of the mother, leading to a higher incidence of premature and weaker births. Increased transmission of infections among closely spaced siblings has also been implicated (Das Gupta).

Older mothers (34 years and older) were associated with higher risk of under-five mortality. This is an expected finding and could be explained by the U-shaped curve shown by the relationship between maternal age (at birth) and neonatal, post-neonatal, infant and under-five mortality. Similar findings have been reported in previous studies (Howlander and Bhuiyan 1999; Woelk et al. 1993). Education of the mother emerged as an important determinant of religious differentials in under-five mortality and is line with several recent studies (Antai et al. 2008; Caldwell and Caldwell 1993; Madise and Diamond 2995).

Residence in rural areas was associated with an increased risk of under-five mortality. Rural residence is often associated with geographic barriers to maternal and child healthcare services (e.g., immunizations, hospital delivery), unemployment, poverty and lack of health-promoting information, and is an important determinant of child mortality. Similar results have been reported from other studies in developing countries (Rutherford et al 2009; Sastry 2004). The association of a high level of community hospital delivery with the lower risk of under-five mortality in this study is in line with expectations, given that timely access to maternal healthcare (hospital delivery) is one of the most important preventive measures of maternal and child deaths (Khan et al. 2006; WHO 2003; Shakya and McMurray 2001). Community hospital delivery is also an indication of the quality of care received by the mother and infant during delivery and an important determinant of under-five mortality as a whole.

Policy measures to reduce child health inequities due to social factors such as religion must consider the importance of the context in which mothers in these communities live. Healthcare interventions to counter these determinants of child health inequities, such as improving the quality

and access to healthcare services and improving maternal education, among others, should therefore be community-specific.

Conclusions

Results of this study reaffirm the need for studies into community-level determinants of child health outcomes. Health interventions need to be tailored toward underlying community-level determinants of child health outcomes, rather than focusing on changing health-seeking norms and practices among members of the different religious groups.

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