



Factors That Predict Differences in Childhood Mortality in Nigerian Communities: A Prognostic Model

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Objective To identify predictors of variations of childhood mortality between Nigerian communities and to identify high-risk communities where childhood mortality was higher than expected.

Study design Secondary analysis of the 2013 Nigeria Demographic and Health Survey data using prognostic univariable and multivariable mixed Poisson regression models. Likelihood ratio test, Hosmer-Lemeshow goodness-of-fit, and variance inflation factor were used to evaluate the fitness of the final model.

Results The final adjusted model revealed that communities with high rating of multiple childhood deprivation (relative risk 1.14, 95% CI 1.09-1.19) and maternal socioeconomic deprivation (relative risk 1.22, 95% CI 1.14-1.29) were associated significantly with the risk of childhood mortality. Communities with enhanced maternal hospital-based health-seeking behaviors and more advantageous environmental conditions had reduced risks of childhood mortality. Similarly, children living in communities with high ethnic diversity were significantly less likely to die before their fifth birthday (relative risk 0.96, 95% CI 0.94-0.97). About 64% of the observed heterogeneity in childhood mortality in these communities was explained by the final model. Eleven of the 896 communities had higher than expected childhood mortality rates during the study period.

Conclusions Of the 31 482 children included in this survey, 2886 had died before their fifth birthday (128 deaths per 1000 live births). There are variations in childhood mortality across Nigerian communities that are not determined only by health system functions but also by factors beyond the scope of health authorities and healthcare delivery systems. (*J Pediatr* 2016;168:144-50).

Childhood mortality in Nigeria is declining gradually from 213 deaths per 1000 live births in 1990 to 128 deaths per 1000 live births in 2013,¹ however, this trend masks the significant inequalities in the preventable deaths recorded in the country. Teenage and young mothers, mothers with no formal education, those residing in rural areas and the North West, and those from the disadvantaged socioeconomic households and communities consistently have worse health outcomes compared with the rest of the population.^{2,3}

The latest report by the Federal Ministry of Health (FMOH) on the National Strategic Health Development Plan (NSHDP) indicate that the underlying risk factors for childhood mortality in Nigeria cluster around teenage and young mothers, socioeconomically disadvantaged households, Hausa/Fulani ethnic group, and those residing in the northwestern and northeastern parts of the country.⁴

As a form of commitment toward the United Nations Millennium Development Goals aimed at reducing health inequalities and the current high level of childhood mortality in Nigeria, the government through the FMOH introduced targets in the year 2010 to reduce the relative gap in childhood mortality by 50% in the most affected social class and regions by 2015.⁴ However, available data from the FMOH since the introduction of the NSHDP target for child's health indicate that childhood mortality remains high in most communities in Nigeria and the target seems difficult to achieve given the current childhood mortality rate, which stands at 128 deaths per 1000 live births across the country with a weak and poorly financed health system.⁵

There is increasing interest in the levels of performance of the interventions adopted in the NSHDP especially in the area of childhood and maternal mortality. Although most communities in Nigeria have poor health outcomes, it is unclear whether such outcomes arise from undernutrition in form of stunting, low

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DHS	Demographic and Health Survey
FMOH	Federal Ministry of Health
MHHSBI	Maternal hospital-based health-seeking behavior index
NSHDP	National Strategic Health Development Plan
VIF	Variance inflation factor

maternal hospital-based health-seeking behavior, low parental levels of education, or region of residency with weak health systems or from other demographic factors such as religion, deprivation, or ethnicity.

Numerous studies have been conducted on the determinants of childhood mortality in Nigeria.⁶⁻¹¹ No studies, however, to the best of our knowledge have examined the factors predicting differences in childhood mortality by community. We sought to identify potential predictors of variations in childhood mortality between Nigerian communities and to identify high-risk communities where childhood mortality was higher than expected.

Methods

This study was based on secondary analyses of cross-sectional population-based data from the 2013 Nigeria Demographic and Health Survey (DHS). Nigeria is a country located in West Africa around the Gulf of Guinea, with a total area of about 923 768 square kilometers. Nigeria is the thirty-second largest country in terms of land mass and the most populous country in the African continent. The latest population and housing census conducted by National Population Commission of Nigeria in 2006 puts Nigeria's population at 140 431 790.² The rural area has about 67.8% of the population, and the urban area has about 32.2%. The population density of Nigeria is about 150 people per square kilometer. There are about 374 identifiable ethnic groups in Nigeria with varying languages, customs, and cultures thereby creating a nation with rich ethnic diversity.² The largest ethnic groups are the Yoruba, Hausa/Fulani, and Igbo, which account for about 68% of the total population.² About 27% of the population is comprised of Ijaw, Kanuri, Tiv, Nupe, Edo, and the Ebiras, and the remaining 5% is made up of the other minority groups. The instruments and conduct of the 2013 Nigeria DHS was approved by the Institutional Review Board of ICF International (Fairfax, Virginia) in the US and Nigeria Health Research Ethics Committee of the FMOH. This study was based on secondary analysis of existing survey datasets from the archive of the DHS who granted us permission for its usage after the identifying information had been removed. This research is limited to the use of previously collected anonymized data.

The 2013 Nigeria DHS was conducted to collect data on demographic, environmental, socioeconomic, and health issues (family planning, infertility, nutritional and health status of children, their mothers, and the fathers) from a nationally representative sample of 39 902 women aged 15-49 years and 18 229 men aged 15-59 years in 38 904 households that were eligible to be interviewed.² The survey included 22 663 households from rural areas and 15 859 households from urban areas. The country by stratification was divided into 37 states including the Federal Capital Territory, which were divided further into 774 local government areas all within the 6 geopolitical zones (South West, South

South, South East, North West, North Central, and North East) to obtain a nationally representative sample. Domains were set up, each one consisting of enumeration areas that were established by the general population and housing census conducted in 2006. The sampling frame is made up of a list of all enumeration areas (clusters).² From each domain, a 2-stage probabilistic sampling method was used for the cluster selections. The first stage involved choosing 896 primary sampling units, 528 in the rural and 368 in the urban areas with a probability proportional to the size. The size in this context is the number of households in each cluster. A second stage of sampling followed, which involved the systematic sampling of households from the selected enumeration areas. Out of all the 31 482 children included in this survey, 2886 had died before their fifth birthday.

The DHS data set has been judged by both international and national health agencies to be the best data available in developing countries in the absence of a viable death registration system. In addition, these data are being used extensively for monitoring and evaluation of implemented interventions. To the best of our knowledge, the DHS is the only nationally representative dataset available in most developing countries. Therefore, its use in this study lends credibility to validity of the study.

Data collection procedures have been published elsewhere.² Data were collected by visiting the selected households and conducting face-to-face interviews with women and men who met the eligibility criteria to obtain information on demographic characteristics, wealth, anthropometry, female genital cutting, and awareness of HIV/AIDS, knowledge of HIV prevention, sexual behavior, and domestic violence. Women in some parts of the country who have limited interaction with men who are not their direct relatives or husbands because of religious and cultural practices were interviewed by female interviewers. Among all eligible individuals and households, the overall participation rates were 98% for both women and households and 95% for men.

Outcome Variable

Each woman interviewed in the survey was asked to provide a detailed history of all her live births in a chronologic order, including whether a birth was single or multiple, the assigned sex of the child, date of birth, survival status, age of the child on the date of interview if alive and if not alive, age at death of each live birth. Childhood mortality rate is the response variable. We estimated from the 2013 Nigeria DHS, childhood mortality rates (defined as number of child deaths reported by women aged 15-49 years as of the interview date divided by total number of births) for the 5 years preceding the survey.

Independent Variables

In this study, we included the following as independent variables; the maternal socioeconomic index, environmental conditions, maternal hospital-based health-seeking behavior, multiple childhood indices, and ethnicity diversity index.

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