Spatial Analysis of Child Mortality in Nigeria

By

Sulaiman Salau
Jacky Galpin

School of Statistics and Actuarial Science

And

Clifford Odimegwu
Graduate Program in Demography and Population Studies

University of the Witwatersrand, South Africa.

One of the Millennium Development Goals is the reduction of under 5 mortality by two-thirds between 1990 and 2015 (UN, 2000). Although there has been a substantial reduction in infant and child mortality rates in most developing countries in the recent past, child mortality remains a major public health issue in developing countries where it is estimated that over 10 million preventable child deaths occur yearly (WHO, 2005). Progress in child mortality reduction remain unacceptable in Sub-Saharan Africa. With special reference to Nigeria, the giant of Africa, available statistics suggest that child mortality levels continue to be high and exhibit wide geographic disparities (NPC, 1998; NPC, 2004).

Previous studies in Nigeria have mainly focused on the contribution of individual and household factors in explaining child mortality differences in the country. Such studies have also found child mortality differentials at aggregated levels of region while neglecting the critical influence of community-level variables and small area variations (see for example: Iyun, 1992; Adetunji, 1994; Folasade, 2000; NPC, 2004). Studying the spatial patterns of child mortality and their determining factors (particularly the community level variables) will help improve our understanding of the mortality situation in the country and subsequently in the design and implementation of policies and interventions to lower disparities and achieve uniform decline nationwide.

This paper examines the role of community level (spatially-determined) variables in predicting childhood mortality in Nigeria and investigates the spatial patterns of child mortality in the presence of spatial autocorrelation. The study employs secondary data from multiple sources, with the major data coming from the 2003 Nigeria Demographic and Health Survey (NDHS) jointly conducted by the National Population Commission

(NPC) of Nigeria and Macro International USA in 2003. The 2003 NDHS is a nationally representative sample of urban and rural areas in which a probabilistic 2-stage sampling design was employed. In the first stage of sampling, 365 Enumerator Areas (EAs) or clusters were randomly selected with probability proportionate to size (PPS) form a list of EAs developed from the 1991 population census. In the second stage, a complete listing of all households in the chosen EAs was obtained from which a systematic random sample of 7,864 households was finally selected. All females between 15 and 49 years and males in the 15-59 age bracket who were permanent residents or visitors present in the households on the night before the survey were eligible for interview (NPC 2004).

Using structured questionnaires, detailed information pertinent to all live births that had occurred to the chosen women in the 5 years before the survey was collected, including: age, sex, birth order, survival status of child, age at death for dead children and various anthropometric information. In addition, the survey collected complete birth history information from all women. Other relevant information collected included woman's age, education, occupation, partner's education, type of place of residence, health seeking information, and household socio-economic data amongst others. A child-based dataset consisting of information from 6029 children borne in the five years preceding the survey was constructed incorporating information from the different questionnaires. The 2003 NDHS also collected using handheld Global Positioning System (GPS) devices, location information (longitudes and latitudes coordinates) for each survey cluster to aid easy linkage of the 2003 NDHS data to other geographically referenced data sources and to facilitate spatial analysis. Other data sources utilized in this study are indicated in table 1 - all datasets were linked together using the cluster location information common to them in a GIS.

Community level health related variables constructed from the 2003 NDHS dataset were also included in our analysis. The impact on child mortality, of most of the variables utilized in our analysis have been highlighted and studied in various previous researches (see for example, Mosley and Chen, 1984; Root, 1997; Balk et al., 2004; Gemperli et al., 2004).

Various statistical techniques including Global and Local indicators of Spatial Autocorrelation (Cliff and Ord, 1981; Anselin, 1995; Ord and Getis, 1995) were employed to test for spatial autocorrelation. Geoadditive discrete time survival models (see Fahrmeir and Lang, 2001 for a review) were used to study the geographic variations in child mortality at state and cluster level while controlling for various individual, household and community characteristics, and resulting maps used to depict the nature and pattern of the spatial distribution of child mortality. Various policy and program implications arising from the findings are discussed, including the usefulness of GIS and Spatial statistics techniques in channelling interventions to areas where they are needed most. Frontiers for further research are identified.

Table 1: Community level Variables used in the spatial analysis of Child Mortality			
Variable	Source data	Source	Description
Demographic:			
Population Density	Gridded Population of the World (GPW) v. 3	CIESIN: www.beta.sedac.ciesin.columbia.edu/gpw	
Urban Proximity	Urban-rural	CIESIN www.beta.sedac.ciesin.columbia.edu/gpw	Distance (euclidean) to nearest urban area
Coastal proximity	Digital Chart of the World (DCW)-derived continent boundary	National Imagery and Mapping Agency (NIMA)	Distance (euclidean) to nearest point on the coastline
Distance to roads	VMAP roads data	National Imagery and Mapping Agency (NIMA)	Distance (euclidean) to nearest point on a road
Ecological:			
Malaria Endemicity	MARA/ARMA	http://www.mara.org.za/lite/information.htm.	
Rainfall	CRU05 0.5 Degree 1961–1990 Mean Monthly Climatology	Intergovernmental Panel on Climate Change/ International Research Institute for Climate Prediction (IPCC/ IRI) at Columbia University: http://iri.ldeo.columbia.edu/	Average monthly rainfall at cluster, in mm/day, 1961–1990
Land cover/Land use	GLC 2000	GLC 2000 http://www.gvm.jrc.it/glc2000/	
Growing season		International Institute for Applied Systems Analysis (IIASA)	Length of growing season, in months