A comparative multilevel analysis of community effects on child mortality in sub-Saharan Africa

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Introduction

Infant and child mortality in sub-Saharan Africa remain a major health problem, and the progress made during the past four decades has been unevenly distributed (Ahmad, et al., 2000; Garenne and Gakusi, 2006). While researchers have devoted considerable attention to the impact of individual-level factors on child mortality, less is known about how community characteristics and institutions affect health outcomes for children, even though they have a prominent role in theoretical models of child mortality (most notably, Mosley and Chen, 1984; Shultz, 1984, 1985). In addition, the incorporation of the role of the community in the analysis of child mortality provides an opportunity to highlight health risks associated with particular social structures and community ecologies, thus providing a policy tool for the development of public health interventions (Pickett and Pearl, 2001; Stephenson et al., 2006). In this paper, we use multilevel models to examine the impact of contextual factors on under-five mortality risk for all sub-Saharan African countries with available data.

Studies carried out during the past two decades have increasingly used multilevel methods to examine the independent effect of contextual factors on child mortality as distinct from the more widely investigated individual factors. In particular, communities’ educational and literacy levels have been found to have a strong effect on children’s health outcomes (Desai and Alva, 1998; Kravdal, 2004; Parashar, 2005; DeRose and Kulkarni, 2005). The level of socioeconomic development also appears to have a positive effect on child health and nutritional status (Sastry, 1996; Kuate-Defo, 2001; Fotso and Kuate-Defo, 2005a, 2005b; Montgomery and Hewett, 2005; Ngnie-Teta, et al., 2007) as
well as access to health care and health infrastructure do (Andes, 1989, 1992; Macintyre et al., 2000; Pickett and Pearl, 2001; Matteson, et al. 1998)

The main weakness of the existing studies is their limited focus (a single country or region within a country) and the heterogeneity in the definitions adopted. Moreover, the still limited availability of community data that can be easily linked to individual-level data from household surveys hinders researchers’ efforts to fully analyze community effects on child mortality. To address these issues, we use data from the latest round of Demographic Health Surveys for all countries in sub-Saharan Africa that include community-level information, and we systematically examine the impact of contextual factors on child mortality. Specifically, we use multilevel discrete-time event history analysis to assess the influence of community population size, average female education, access to medical facilities on the risk of dying before age 5. Our preliminary finding is that the introduction of community-level controls significantly reduces the impact of individual-level factors on child mortality in all contexts.

**Data and methods**

**Data sources**

We use data from the latest round of Demographic Health Surveys for all countries in sub-Saharan Africa that include community-level information. These are: Benin (2001), Chad (2004), Gabon (2000), Guinea (1999), Mali (2001), Mauritania (2000/01) and Nigeria (1999). Overall, the analysis concerns children born in 48539 families nested in a sample of 2047 clusters (communities).

**Methods**

We use multilevel discrete-time event history analysis (Allison, 1982; Singer and Willett, 2003) to analyze community-level effects on child mortality. The multilevel approach allows for correlation in mortality risks between children by including in the model a community/family-specific random effect.
The outcome variable of interest is the risk of death in childhood (0-59 months) measured as the duration from birth to the age at death, or censored. Due to the hierarchical nature of the data, a tree-level model is used in the analysis. Assuming a logit link between the hazard rate and the explanatory variable, the tree-level random-effects discrete-time hazard model can be expressed as:

$$\ln \left( \frac{h_{ijk}}{1 - h_{ijk}} \right) = \alpha_t + X_{tijk}\beta + \omega_{jk} + \nu_k,$$

where

- $h_{ijk}$ is the probability of dying before age 5, child referenced ($i =$child, $j =$household, $k =$cluster)
- $X_{tijk}$ is a vector of covariates corresponding to the $i^{th}$ child of the $j^{th}$ family in the $k^{th}$ cluster, which may take on different values at different discrete times,
- $\alpha_t$ is a function of time and is defined for age,
- $\beta$ is a vector of unknown regression parameters associated with the explanatory variables,
- $\omega_{jk}$ is a residual error term associated with the $j^{th}$ family in the $k^{th}$ cluster, and
- $\nu_k$ is a residual error term associated with the $k^{th}$ cluster.

Models are fitted using the MLwin software with Binominal, Predictive Quasi Likelihood (PQL) and second-order linearization procedures (Rasbash, et al., 2000; Goldstein, et al., 2002; Browne, et al., 2005;).

**References**


