Within-country variation in under-5 mortality in Bangladesh, Mozambique, Uganda, and Zambia

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Abstract

Between-country inequalities in under-5 mortality are substantial and well documented. Significant within-country inequalities likely also exist but have not been extensively explored in many developing countries. In this analysis, we estimate district-level trends in under-5 mortality for Bangladesh, Mozambique, Uganda, and Zambia. We apply demographic methods for birth history analysis to available survey and census data in each country. We then apply small area models to these data to estimate time trends in under-5 mortality. These small area models borrow strength across both time and space to improve predictions for each district, even in cases where there is relatively limited data available for a particular district. We use these predictions to explore within-country spatial patterns in levels and trends in under-5 mortality. We also assess the extent of inequality within each country and compare across the four countries.

1 Background

Under-5 mortality is a commonly used indicator of child health and survival as well as overall development. There are well documented and considerable differences in the level of under-5 mortality between countries, especially when comparing developing to developed countries. Much less attention has been paid, however, to how under-5 mortality varies within countries, especially when considering developing countries where data on under-5 mortality for small geographic areas are more sparse. In this analysis we aim to estimate trends in under-5 mortality at the district level in four countries: Bangladesh, Mozambique, Uganda, and Zambia. This will allow us to describe spatial patterns in both the level and trends in under-5 mortality within each country as well as allow us to evaluate how within-country variability compares across these four countries.

2 Methods

We utilize previously reported methods for estimating under-5 mortality at subnational levels in developing countries[1]. In summary, we employ a two-stage procedure:

- First, we apply established demographic methods to summary and complete birth history data from surveys and censuses in order to generate preliminary, source-specific estimates of under-5 mortality at the district level.
- Second, we apply small area models to these preliminary estimates to synthesize estimates from all available data sources. These models are designed to address the issues posed by small numbers at the district level by borrowing strength over time and from neighboring districts.

2.1 Birth history methods

Birth history data are collected from women interviewed in many surveys and censuses and consist of information about their fertility and the mortality experience of their children. We considered two types of birth histories in this analysis. First, complete birth histories, where information is collected about each child a woman has given birth to, including the birth date, survival status, and age at death. Second, summary birth histories, where aggregate information, including the total number of children born and the number of those children who have died, is collected about each woman. In both cases, we use established demographic methods to estimate under-5 mortality from these data [2]. Table 1 summarizes the data available for this analysis in each of the four countries.

Table 1: Birth history data available for this analysis.

Country	Source*
Bangladesh	1993-94 DHS, 1996-97 DHS, 1999-00 DHS, 2001 DHS, 2004 DHS, 2007 DHS, 2011-12 DHS.
Mozambique	1997 Census, 1997 DHS, 2003 DHS, 2007 Census, 2008 MICS, 2009 AIS, 2011 DHS.
Uganda	1988-89 DHS, 1991 Census, 1995 DHS, 2000-01 DHS, 2002 Census, 2004-05 AIS, 2006 DHS, 2009-10 MIS, 2011 AIS, 2011 DHS.
Zambia	1990 Census, 1992 DHS, 1996-97 DHS, 2000 Census, 2001-02 DHS, 2007 DHS, 2010 Census.

* DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey; AIS = AIDS Indicator Survey; MIS = Malaria Indicator Survey.

2.2 Small area models

Estimates of under-5 mortality from a single survey or census may be unreliable at the district level. This is primarily because the number of women interviewed is generally small for any individual district and the sampling error can be quite large. Additionally, estimates of under-5 mortality may vary between sources, even when sampling variability is not an issue, due to non-sampling error (i.e., biases). We employ small area models to help address both of these issues. These models explicitly exploit spatial and temporal relationships, effectively "borrowing strength" over time and space to overcome issues related to small numbers. Further, by incorporating multiple data sources into these models, we hope not only to improve estimates by increasing the total sample size available for each district, but also to mitigate the effects of source-specific non-sampling error by averaging across all sources.

We build on the small area models used for subnational child mortality estimation in previous analyses [1]. These models are generalized linear mixed models which incorporate spatial effects, temporal effects, and spatial-temporal interactions. A number of different forms for each component – the spatial, temporal, and spatial-temporal – were considered for the previous analyses and will be tested for this application. Additionally, in this analysis we intend to further develop these models in two ways:

1. We will develop methods for estimating the effective sample size for each preliminary under-5 mortality estimate derived from the birth histories and explicitly incorporate this information into the small area models.
2. We will modify the models to allow data to be incorporated regardless of the precision of the geographic identifiers available in this data. Previous applications have been restricted to data which include

district identifiers or GPS coordinates, but this development will allow us to include additional data with other types of geographic information.

3 Preliminary Results

As a first step in this undertaking, we have analyzed birth history data and applied preliminary small area models to estimate under-5 mortality in provinces in Mozambique and in regions in Uganda. We will ultimately expand this analysis to include all four countries at the district level.

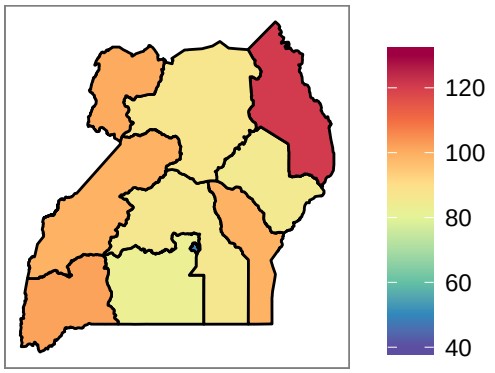

Figure 1: **Under-5 mortality in Uganda regions in 2011.**

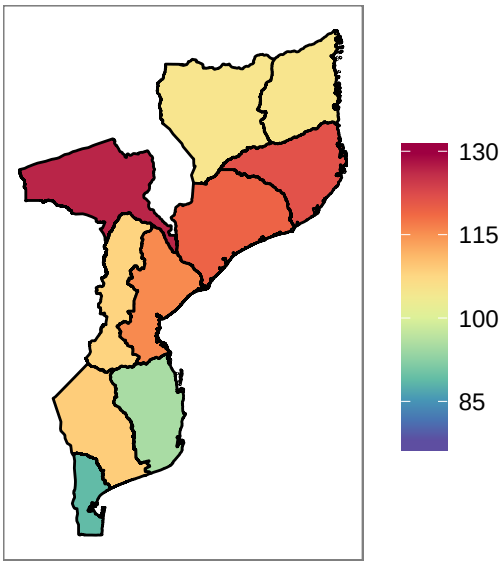

Figure 2: **Under-5 mortality in Mozambique provinces in 2011.**

Figure 1 shows under-5 mortality at the region level in Uganda in 2011. In this year, under-5 mortality in Uganda ranged from 50.3 deaths per 1,000 live births in Kampala, the capital, to 120.5 in the Karamoja

region, an absolute difference of 70.2 and a 2.4-fold relative difference. Under-5 mortality declined in every region of Uganda between 1990 and 2011, but declines were not uniformly realized, ranging from 38.4% to 54.5%.

Figure 2 shows under-5 mortality at the province level in Mozambique in 2011. In 2011, under-5 mortality in Mozambique ranged from 73.6 in Cidade de Maputo, the capital, to 136.1 in Tete province. This is an absolute difference of 62.6 and a 1.9-fold relative difference. As in Uganda, under-5 mortality declined in every region of Mozambique between 1990 and 2011, and the extent of these declines was even more variable, ranging from 29.5% to 54.8%.

4 Conclusions

Initial region- and province-level analyses in Uganda and Mozambique highlight considerable within-county variation in under-5 mortality and we expect that variation measured at the district level may be even more dramatic. Subnational estimates of under-5 mortality such as these highlight particular areas that are especially high need, allowing for effective targeting of interventions to reduce under-5 mortality overall and to promote equity within each country.

Acknowledgements

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References

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