TITLE: Measuring Under-Five Mortality: Validation of New Low-Cost Methods

Detailed Abstract

Background: There has been increasing interest in measuring under-five mortality as a health indicator and as a critical measure of human development (Murray Laakso Shibuya Hill Lopez, MDG4 cite). In countries with complete vital registration systems that capture all births and deaths, under-five mortality can be directly calculated. In the absence of a complete vital registration system, however, child mortality must be estimated using surveys which ask women to report the births and deaths of their children. Two survey methods exist for capturing this information: complete birth histories and summary birth histories. A summary birth history includes only two questions: how many live births has each mother ever had and how many of them have survived. Indirect methods are then applied using the information from these two questions and the age of the mother to estimate under-five mortality going back in time prior to the survey. Estimates generated from complete birth histories are viewed as the most accurate when surveys are required estimate under-five mortality, especially for the most recent time periods. However, it is much more costly and labor intensive to collect this detailed data, especially for the purpose of generating small area estimates. As a result, there is a demand for improvement of the methods employing summary birth history data to produce more accurate as well as sub-national estimates of child mortality.

Methods and Findings:
We use data from 169 DHS to develop new empirically-based methods of estimating under-five mortality using children ever born and children dead data. We develop a range of methods based on three dimensions of the problem: a) approximating the average length of exposure to mortality from a mother's set of children using either maternal age or time since first birth; b) using cohort and period measures of the fraction of children ever born that are dead; and c) capturing country and regional variation in the age pattern of fertility and mortality. We focus on improvement of estimates in the most recent time periods prior to a survey where the traditional indirect methods fail. In addition, all of our methods incorporate uncertainty. Validated against under-five estimates generated from complete birth histories, our methods outperform the original indirect methods by an average of 45%, and in the five years prior to the survey, the new methods result in a 62% improvement. An example of the methods applied to the 1998 Bolivian DHS is shown below. Finally, to illustrate the value of this method for local-area estimation, we apply our new methods to the analysis of summary birth histories in the 2000 Brazilian Census, generating estimates of under-five mortality by municipality.

Conclusions:
The new methods presented significantly improve the estimation of under-five mortality using summary birth history data. In areas without vital registration data, summary birth histories can provide accurate estimates of child mortality. Because only three questions are required of a female respondent to generate this data, they can easily be included in existing survey programs as well as routine censuses of the population. With the application of these methods to census data, countries have a new tool to generate

estimates for sub-national areas and population subgroups, important for measuring and addressing health inequalities and developing local policy to improve child survival.

Figure 1: A preliminary example of five new indirect methods to estimate under-five mortality. The green line is the gold standard estimate, generated from complete birth histories pooled across all surveys in Bolivia. The blue line represents estimates from complete birth histories from the 1998 DHS. The red line is the original indirects developed by Brass and elaborated by Sullivan and Trussell. The yellow, pink, orange and brown lines we refer to as the maternal age period (MAP), time since first birth period (TFBP), maternal age cohort (MAC) and time since first birth cohort (TFBC) methods, respectively. The purple line is generated by local regression of the estimates of the MAC and TFBC methods, the two best performing of the four new methods. Note how the original indirect methods perform very poorly in the time immediately prior to the survey. The new methods also generate estimates going back farther in time, nearly 30 years of historical estimates are provided by the period methods. Uncertainty has also been computed for each of the MAC, MAP, TFBC, TFBP and the local regression methods, but is not shown in this figure.