Lessons learned with the application of indirect methods for the evaluation of (infant) death registration in Central Asian republics by subnational characteristics

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Background

In 2013, I conducted with collaborators a study of infant mortality in Kyrgyzstan, which was published in *Population Studies* (attached). The purpose of the study was not to evaluate death registration per se, but to examine the impact of the break-up of the Soviet Union on infant mortality in this Central Asian republic, using all available sources. This study was conducted in collaboration with the National Statistical Committee (NSC) of the Kyrgyz Republic, and thus we had access to more detailed vital registration information than typically available.

While conducting the study, it quickly appeared that the Vital Registration (VR) information used by NSC for producing official IMR levels had some important flaws. First, the levels of IMR reported in the VR data were much lower than those reported by sample surveys such as the DHS, which suggested an important amount of under-registration. Second, the VR information showed suspicious patterns by sub-groups. Rural areas, which presented higher IMR levels than urban areas during the Soviet period (as expected), started to present a mortality *advantage* after the country's independence in 1991. Moreover, the VR data presented a rather implausible pattern of narrowing of the IMR ethnic differential (Slavs vs. Central Asians). These patterns of errors motivated us to design an adjustment procedure specifically tailored to address Kyrgyzstan's data circumstances, but with implications beyond this country.

Approach

This study used a variety of sources to estimate IMR levels and trends, including full birth histories in the DHS and summary birth histories in the MICS and census data. Standard methods were used for these sources ("direct" for DHS and "indirect" for MICS and census data).

In addition, this study devoted particular attention to the design of a procedure for adjusting the VR-based IMR information. Details of the procedure are explained in the published article (attached), but the logic of the approach rests on the following principles:

1) After examining the age pattern of mortality below age 2 in the VR data by month of age, we realized that while the reported IMR was severely affected by underreporting of deaths and age heaping issues, the reported life table probability that a child age 3.0 months will die before reaching age 24.0 months ($_{21}q_3$) was much less likely to be underestimated.

2) We observed that in Sweden and England & Wales, there was a very strong log-log linear relationship between IMR and $_{21}q_3$ going back to at least the beginning of the twentieth century. The relationship was nearly identical in the two countries.

3) We observed that until 2004, the IMR vs. $_{21}q_3$ relationship was very different in the VR data for Kyrgyzstan and indicative of IMR underestimation. After 2004, following an important improvement in the way neonatal deaths were recorded in Kyrgyzstan (change of definition of stillbirths vs. live births), the IMR vs. $_{21}q_3$ relationship became very similar to that observed in the Swedish and English data.

4) We thus decided to model the IMR vs. $_{21}q_3$ relationship using the Swedish and English data, and to use this model for predicting the IMR in Kyrgyzstan on the basis of the VR-based level of $_{21}q_3$. This model was applied to produce IMR levels and trends at the national level, but also by urban/rural residence and ethnicity.

5) Adjusted IMR levels were compared to those produced by DHS, MICS and census data for the years when they overlap. The consistency between the different approaches was high. Using the DHS direct estimates as a gold standard, we concluded that the proposed procedure was a useful way of adjusting the VR-based IMR information in Kyrgyzstan.

Note that the proposed VR adjustment approach was not specifically designed to estimate the coverage of death registration at infant or child ages. However, a comparison of the unadjusted vs. adjusted IMR levels is indicative of the coverage of infant deaths in the VR data (or at least indicative of the coverage of infant deaths relative to the coverage of live births).

Lessons learned

1) In Kyrgyzstan, a country which until recently had a large amount of death registration incompleteness at infant/child ages, under-registration was not systematic but highly variable by age. While deaths below 3 months were strongly under-registered, completeness after age 3 months appeared much more reliable.

2) Registered deaths presented a large amount of age heaping at age 12 months, which contributed to the low level of official IMR in the country.

3) These two problems were relatively well addressed using model age patterns of mortality, i.e., regularities in how mortality at certain ages is correlated with mortality at other ages. The adjustment was successful in the sense that it produced levels of IMR that were similar to those produced by sample surveys.

4) Relative to the information provided by sample surveys, the adjusted VR information had several advantages. First, it was able to detect time patterns not apparent in the combined survey information, including a period of stagnation in the IMR during the 1990s. Second, the adjusted VR provided more up-to-date IMR information than survey data. At the time of the study, the most recent survey-based data point referred to 2003, while the adjusted VR information was available until 2010. Third, the adjusted VR information was advantageous (relative to survey data) for the estimation of levels and trends in IMR by subgroup (i.e., urban/rural residence, ethnicity). For example, due to small sample size, the estimation of IMR among Slavs was not possible using the DHS or the MICS.

5) This adjustment procedure was seen as useful by the National Statistical Committee. During the course of the study, the NSC confronted the deficiencies in their VR information, which were particularly apparent when examining age or subgroup breakdowns. However, they were also reassured that the VR information did not need to be completely discarded and contained sufficient information to form the basis of an adjustment procedure, allowing the detection of patterns not seen in the survey data. The adjustment procedure also produced helpful information for improving the quality of their VR system. For example, the adjusted data showed that many rural deaths were misreported as "urban," due to confusion between place of residence and place of occurrence in the VR system. Finally, the adjustment procedure was easy to understand and implement by the NSC staff.

Remaining issues

Given some of the advantages of the adjustment procedure used in Kyrgyzstan, we see this approach as potentially useful for adjusting VR information more broadly in countries with functioning but incomplete VR systems. However, the generalization of this approach requires addressing the following issues:

1) The model age patterns used in this study were rudimentary (based on only two populations, i.e., Sweden and England & Wales). Although the approach was successful in the sense that it produced plausible IMR patterns in Kyrgyzstan, the generalizability of the model is questionable.

2) The approach worked well to address the specific problems with the infant mortality information in Kyrgyzstan, including issues of definition of stillbirths vs. live births. These problems are likely to be also present in the VR data for other Central Asian republics, or more generally for other republics of the Former Soviet Union. Although promising, it is not clear at this point if a similar procedure could be used to evaluate the quality of VR-based IMR or U5MR in other countries with incomplete VR data. The procedure will probably work well for countries where under-registration issues below age 5 are concentrated at young ages (e.g., neonatal ages), but it is not clear how many countries fall in that category.

3) Uncertainty around adjusted estimated was not addressed in the Kyrgyzstan study.

Plans for future research and recommendations

1) The model age patterns presented in the Kyrgyzstan study should be expanded such that they cover the global diversity of epidemiological environments. This includes both more- and less-developed settings.

2) The indirect estimation procedure based on these models should be flexible enough such that they can be accommodated to country-specific under-registration issues. While ${}_{21}q_3$ was a useful entry point in the adjustment model for Kyrgyzstan, other entry points may be more relevant in other countries.

3) The indirect estimation procedure should be able to produce uncertainty intervals around adjusted estimates.

4) The performance of this approach in countries outside the Former Soviet Union should be examined. Countries of the Middle East and North Africa (MENA) region are particularly promising candidates for a productive application of this procedure.

5) This procedure relies on death distributions by detailed age, including months or trimesters during the second year of life. While age details are broadly available below age one, they are much less available at age one or above. Countries should be encouraged to publish such information (by sex and other subgroups), or make it more easily available to analysts.

Note that an R01 research proposal addressing these issues has been submitted to the NIH (funding status pending as of 26 October 2016).