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Urban-rural disparity and urban population growth: A multilevel analysis of under-5 mortality in 30 sub-Saharan African countries

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ABSTRACT

Objectives: To assess whether country-level urban population growth is associated with the magnitude of the urban-rural disparity in under-five mortality (U5M) using ecologic and multilevel analyses.

Methods: We used data from 2010 to 2015 Demographic and Health Surveys and World Bank data from 30 sub-Saharan African countries (n = 411,054 women). Country-level linear regressions determined associations between urban population growth and economic growth between 2005 and 2010 on U5M risk differences. Multilevel logistic regression models were used to determine the impact of urban population growth on the urban advantage in U5M, adjusting for child and maternal factors.

Results: Countries with greater urban population growth and low economic growth had greater disparities in U5M between urban and rural areas. After adjusting for known U5M risk factors in multilevel analyses, interactions between country-level urban population growth and urbanicity were identified.

Conclusions: Continued efforts to evaluate and address disparities in child mortality outcomes in sub-Saharan Africa should acknowledge urbanicity in context, as well as socioeconomic and geographic realities of families, mothers and children. Low-resource, demographically shifting environments require novel strategies to decrease child mortality.

1. Introduction

Deaths among children under the age of 5 continues to be an actionable clinical and public health issue globally. In 2015, an estimated 16,000 children under the age of 5 died each day, with 5.9 million children dying over the course of the year worldwide. Almost half of under-5 deaths occur in sub-Saharan Africa (SSA) and the vast majority of these child deaths are due to preventable causes (Department of Evidence, 2016; Liu et al., 2016). While recent declines in child mortality in SSA are encouraging, only one quarter of SSA countries met Millennium Development Goal targets and seven countries in SSA have under-5 mortality rates that exceed 100 deaths per 1000 live births (You et al., 2015).

Significant variation in under-5 mortality rates, disparities, and progress has been identified across the region. Considerable empirical efforts have been made to quantify and understand this variation, both cross-nationally and subnationally. Multinational inquiries have used national macrolevel data, including educational, health, and economic systems, to explain between-country variation (Gakidou et al., 2010; Jamison et al., 2016; O'Hare et al., 2013). In contrast, others have focused on within-country variation in under-5 mortality. Using increasingly granular geospatial techniques, variations in under-5 mortality have been well-documented and offer promising guidance on where efforts to reduce under-5 mortality should be focused in order to have the greatest potential contribution (Golding et al., 2017; Burke et al., 2016; Pezzulo et al., 2016). Research focusing on variation across the region has largely focused on the drivers of variation, i.e. whether country-level factors or subnational distributions are more important to under-5 mortality. By viewing country-level and subnational explanations as alternatives to one another, these models do not account for the important role that macro-level factors at the country-level may play in understanding within-country disparities. By focusing on urban-rural disparities as an example, the present research hypothesizes that country-level factors impact the magnitude of subnational variation and should therefore be considered simultaneously.

In low-income and developing countries, research on urban-rural disparities in child health using cross-national data has focused on the urban advantage (Fotso, 2006; Van de Poel et al., 2007). However, sub-Saharan Africa is undergoing a rapid demographic shift with increasing proportions living in urban areas. Nine of the ten countries with the greatest urban population growth are located in SSA (United Nations Department of Economic and Social Affairs Population Division,

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2016a). This transition has brought renewed attention to comparisons between urban and rural areas and how these characteristics may impact health equity. More recently, studies have suggested that much, if not all, of the urban health advantage may be explained by socioeconomic factors, such as family wealth and maternal education (Van de Poel et al., 2007; Fotso, 2007; Kimani-Murage et al., 2014).

Since the 1960s, SSA has been marked by urban population growth coupled with economic stagnation (Fox, 2012). Despite this significant urban population growth in the region, almost two-thirds of SSA residents continue to live in rural areas (United Nations Department of Economic and Social Affairs Population Division, 2016a). Understanding the relation between urban population growth and this disparity can improve our ability to predict changes in child survival and distribute resources accordingly. Appreciating the potential of cities to provide health-promoting opportunities is essential for the future of population health; yet, largely absent from the discussion of urban population growth on health is the impact of urban population growth on rural areas. In order to continue to make progress towards child survival goals, we must examine not only what the intersection of urban population growth and economic stagnation means for the health of the urban population, but also for the rural population that remains.

This study uses nationally representative data from 30 SSA countries to: (1) first, identify the intra- and multi-national urban-rural disparity in child mortality across 5 years, (2) then, assess the association between country-level urban population growth, economic growth and child mortality disparity using country-level regression models, and (3) finally, using multilevel models, determine whether country-level urban population growth, and economic growth interact with urbanicity to explain urban-rural disparities, even after adjusting for individual level factors.

2. Methods

2.1. Data sources

Data for this research come principally from the Demographic and Health Survey (DHS) (Rutstein and Rojas, 2006), rounds 6 and 7, with additional data on predictors coming from the World Bank Global Development Indicators (World Bank, 2016). The DHS is a nationally, residentially (i.e. urban and rural), and regionally representative survey, typically conducted every 5 years to identify trends in demographics, women's, and children's health. DHS surveys are conducted by the DHS program, which is funded by USAID, in conjunction with the host nation. The sample is identified through a stratified two-stage cluster design. Response rates are very high, typically over 90%. This research utilized data from the women's questionnaire, conducted between 2010 and 2015 with all women aged 15–49 years old in a selected household. The women's questionnaire included extensive information on her household, health, and the birth and health of all her biological children. We limited analysis to women with children who were born within 5 years of the survey date. If a country had multiple available surveys, the most recent survey was used. Based on these requirements, 30 SSA countries were included in this analysis, with surveys from 411,054 women representing 339,028 children who were born in the 5 years before the survey. Surveys used for each country are described in Table 1.

We collected country-level variables of urban-population growth and Gross National Income (GNI) from the World Bank Global Development Indicators, which are reported yearly. Specifics of the data sources by country are described at length by the World Bank (2016).

2.2. Measures

2.2.1. Country-level outcomes and predictors

To assess country-level disparities in under-5 mortality, we calculated under-5 mortality rates (U5MR) by country as well as by urban and rural residence, which are defined dichotomously by the DHS. The U5MR was defined as the probability of dying between birth and the fifth year of age (or between age 0 and 59 months) per 1000 live births. We calculated the U5MRs using the period analysis approach for direct estimation from the full maternal birth history within the DHS women's questionnaires for the 5-year period before survey. This approach takes into account the birth date of a child, date of death of a child (if applicable), and survey date and allowed for calculation of mortality rates directly before the survey. All dates were self-reported by women aged 15–49 years.

The outcome of primary interest is the urban-rural disparity in U5MR. We defined risk differences as the rural mortality rate per 1000 live births in the 5 years preceding the survey minus urban mortality rates per 1000 live births in the 5 years preceding the survey. Positive coefficients indicate an urban advantage (i.e. fewer deaths in urban areas) while negative coefficients indicate a rural advantage. Predictors at the country-level were (1) urban population growth, defined as the increase in the urban population from 2005 to 2010 as a percentage of the 2005 urban population, as reported by the World Bank and the United Nations population estimate, and (2) economic growth, measured using the GNI per capita growth from 2005 to 2010 as reported by the World Bank.

Definitions of “urban areas” are defined by the country, as is recommended by the United Nations, and are consistent between the data sources used in this analysis (United Nations Department of Economic and Social Affairs, 2008). This approach allows for some definitional variation between countries in order to ensure classification is appropriate for the country. Almost all definitions for countries in this analysis categorize urban and rural areas primarily by their population size and/or administrative role. Generally, urban areas are administrative centers which are larger in population, with parameters varying by country context. Individual country-level definitions are provided in detail in Appendix A.

2.2.2. Individual-level outcomes and predictors

To identify the variation in child mortality explained at the country-, community-, and individual levels, we also defined under-5 mortality at the child-level as the likelihood of death between 0 and 59 months among children who were born alive in the past 5 years. This data came from the full maternal birth history in the DHS women questionnaires and was self-reported by women age 15–49.

Urban or rural designation was defined by the DHS at enumeration-area (EA), the geographic area that was used in the sample design. These designations matched the definition in the “country-level” analysis section.

Individual and household covariates included were child sex, birth cohort (i.e. child age in months at survey regardless of survival status), maternal age at child birth in 5 year intervals, short birth spacing (less than 18 months between child's birth and previous birth), birth order, not a singleton birth, mother reporting the death of another child, mother's total number of births, maternal education level, and household wealth quintile. Additionally, we included the previously defined macro-level factors at the country level.

2.3. Statistical analysis

We used Rao-Scott chi-square tests to identify bivariate correlations between covariates and mortality. To identify the association between the urban and rural mortality disparity and economic growth and urban population growth, we conducted country-level linear regression. Specifically, at the country-level, we regressed the U5MR risk difference on the macro-level covariates, adjusting for country-wide U5MR. Then, to further examine the impact on country-level urban population growth on urban rural disparities, we turned to multi-level models. To identify the interactions between economic growth, urban population