Urban-Rural Differentials in Child Malnutrition: Trends and Socioeconomic Correlates in Sub-Saharan Africa

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1. Background

Over the last few decades, the world has witnessed a dramatic growth of its urban population. Forty-eight per cent of the world's population lived in urban areas in 2003, and the rate is projected to exceed 50 per cent by 2007, thus making it the first time in history that the world has more urban than rural residents (United Nations, 2004). Within this general context, cities in sub-Saharan Africa (SSA) have experienced the fastest population growth, and most of the future population growth in the region is expected to occur in urban areas (APHRC, 2002; Magadi et al., 2003). Moreover, migration streams to urban areas, that have been the main fuelling factor of the population growth in cities, are generally composed of disadvantaged families, which may have a harder time coping in urban areas than in rural areas (Sastry, 2004).

Unfortunately, Africa's rapid urbanization has been occurring amidst stagnating or declining economies. It is estimated that between 1980 and 2000, urban population in SSA grew by almost 4.7% per year (United Nations, 2004), while per capita gross domestic product (GDP) dropped annually by 0.8% (World Bank, 2003). This situation has hampered the ability of local and national authorities to provide minimally decent living conditions and basic social services to the new entrants into urban economies, which are already severely strained (Brockerhoff and Brennan 1998; Magadi et al., 2003). Consequently, a rapidly increasing proportion of urban dwellers in SSA are living in overcrowded slums and shantytowns amidst filthy conditions, characterized by uncollected garbage, unsafe water, poor drainage and open sewers, which in turn, worsen their susceptibility to various health problems (Zulu et al., 2002; APHRC, 2002). Vast amounts of records indeed attest to the extreme unsanitary and congested conditions which prevail in some parts of urban areas to such an extent that epidemics and outbreaks of diseases like cholera are common and often endured for extended periods, causing tremendous increases in malnutrition, ill-health and mortality, especially among children (Gould, 1998). The explosive growth of urban informal settlements challenges the commonly-held assumption that the economic conditions and health of urban populations are superior to those of rural dwellers. Indeed, emerging evidence demonstrates that in some countries like Kenya, urban poor children exhibit poorer health and nutritional outcomes than even those in rural areas (APHRC, 2002).

Yet, most studies continue to show that the conditions that affect health in developing countries are more favorable in cities than in rural areas. In the less developed countries, place of residence usually determines people's life-styles, their economic, social and cultural activities, and, most importantly, their health conditions (United Nations, 1985). One of the reasons forwarded to explain the urban health advantage has been that unlike villages, cities generally have an important modern health care system -which facilitates public health interventions, such as campaigns to control epidemic diseases, vaccination and maternal-and-child health programs-, compared to rural areas. Some studies point out that even when health facilities are available in rural areas, they are often ill-suited to deliver the primary health services needed by the rural populations, and that people have to travel a greater distance to obtain care than do urban dwellers (Sastry, 1997; Lalou and Legrand, 1997; United Nations, 1985).

The urban environment is also generally more salubrious. Furthermore, the development of road and rail links ensures that urban populations receive a fairly regular and abundant supply of food-stuffs. Another general presumption in the literature is that urban populations generally have an advantage over rural people in the availability of water supply, housing and sanitation, and other areas of social programming that directly affect health and mortality. Overall, cities are perceived as having a concentration of wealth, power and western culture, together with services and modern equipment, whilst villages spell out poverty, underdevelopment and lack of services (Kuate, 1996; Lalou and Legrand, 1997).

This theoretical interpretation of the urban advantage has been substantiated by a number of studies attesting that rural children stand greater risk of being malnourished or sick, or of dying, than their counterparts in urban settings. In fact, following maternal education, the type of place of residence (rural versus urban) is one of the socioeconomic covariates most frequently used in studies of child nutrition and survival in the developing world (Sastry, 1997). However, the urban advantage -particularly in child health- has supposedly faded in recent decades, since the urban population explosion in most sub-Saharan African countries has not been matched by an adequate expansion of sanitation, health services and livelihood opportunities, as previously noted (Brockerhoff and Brennan 1998; Lalou and Legrand, 1997).

Although many studies have documented health differentials by rural-urban place of residence in less developed countries, and particularly in SSA (Smith et al., 2005; Fotso and Kuate, 2005b; Garrett and Ruel, 1999; Sastry, 1997), little is known about how these differentials have changed over time as levels of urbanization rose and the social and economic development processes unfolded. A study by Gould (1998) showed that the urban-rural mortality gap in Kenya has narrowed within the last half-century, as a result of rapidly declining rural mortality over most of the period, and more recently, due primarily to a stalling and even upturn in urban mortality, resulting from the deterioration of living conditions in rapidly growing cities. Assessing the robustness of this finding on a larger sample of countries, and using other health outcomes like malnutrition, is likely to provide important insights into the issues of urbanization and child health differences across rural and urban areas in SSA.

Another key question has to do with the origin of these urban-rural gaps in health (Stafford et al., 2001; Senior et al., 2000). Traditional theories tend to emphasize contextual and compositional explanations of differences in health by location of residence (Kawachi et al., 2002). In the former, variations in health outcomes or status arise from differences in urban or rural settings per se, and the very characteristics of cities as compared to rural areas are seen as major determinants of health experiences of individuals living in these areas. In the compositional perspective, explanations are sought in terms of differences in cultural and socio-demographic characteristics between urban and rural dwellers (Diez-Roux, 2001; Senior et al., 2000; Duncan et al., 1998; Kawachi et al., 2002). Indeed, urban and rural populations differ in respect to level of literacy, educational status, income per head, and in other respects that have an important bearing upon health (Sastry, 1997; Lalou and Legrand, 1997; Kuate, 1996).

A number of authors have reported that urban-rural gaps in health even persist when differences in the composition of rural and urban populations are taken into account (Adair and Guilkey, 1997; Madise et al., 1999; Tharakan and Suchindran, 1999; Sastry, 1997). Some recent studies of health determinants, however, concur that the effect of residence on health is reduced to statistical insignificance when socioeconomic characteristics are adjusted for (Senior et al., 1999). In particular, work by Fotso and Kuate (2005b) in five African countries and two time periods revealed that urban-rural differentials in child health (measured by malnutrition and diarrhea morbidity) were abolished once the SES of households and communities were controlled. Thus, overall, there is an important research gap in documenting and explaining rural-urban differentials in health in less-developed countries, particularly the extent to which they are explained by contextual or compositional factors.

Against this background, it is the purpose of this study to contribute to improving our understanding of differentials in child undernutrition by place of residence, and shed light on the factors underlying these differences. The study examines how wide rural-urban gaps in child malnutrition are over time, and investigates whether child health is intrinsically better in urban areas given comparable socioeconomic conditions. Specifically, the objective of this work is to test the following hypotheses: (i) urban-rural differentials in child malnutrition have declined over time; and (ii) they are fully accounted for by the socioeconomic status of communities and families[1]. This latter question conveys an important policy implication, since it relates to whether health differences across urban and rural areas simply reflect inequalities between socioeconomic groups or, more significantly, suggest a contextual effect of place of residence in shaping the health of populations (Kawachi et al., 2002).

This paper differs from the aforementioned studies in a number of respects. First, it uses more standardized measures of the SES defined at both household and community levels. Indeed, in the absence of standard conceptualization and measurement of SES in health-related studies (Oakes and Rossi, 2003), researchers have typically used their own socioeconomic indicators, usually consisting of various indicators at the individual, household or community level, and thus making comparisons difficult. More importantly, when covariates are strongly collinear, as socioeconomic factors are likely to be, it may be very difficult and perhaps not very meaningful to tease apart their independent effects (Campbell and Parker, 1983). Second, the modelling strategies of most of the previous work ignore the multilevel nature of influences on health and the hierarchical structure of the data used. It is indeed important to specifically acknowledge the different levels at which determinants of undernutrition may operate (Madise et al., 1999; UNICEF, 1990), as we do in this paper. Third, this work is based on a larger sample of countries, representing the geographic, social and economic diversities of SSA.

This study focuses on malnutrition among children since it is one of the major public health concerns in developing countries, where it represents both a cause and a manifestation of poverty

[1] The terms "Household" and "Family" are used interchangeably in this paper.

(UNICEF, 1998; ACC/SCN, 1997; Adair and Guilkey, 1997). The evidence of short and long-term consequences of nutritional deficiencies include increased risk of both morbidity from infectious diseases and mortality, impaired cognitive or delayed mental development, and subsequently, reduced learning abilities in school, and poor work capacity in adulthood. There is also growing evidence of heightened susceptibility to poor reproductive outcomes and to obesity and chronic diseases in later life (Gopalan, 2000; De Onis et al., 2000; Adair and Guilkey, 1997; Ricci and Becker, 1996). Ultimately, malnutrition hinders human capital and contributes to the perpetuation of the cyclical nature of poverty (UNICEF, 1998; ACC/SCN, 1997). Conversely, child undernutrition in developing countries is usually a consequence of poverty and its attributes of low family income, large family size, poor education, poor environment and housing, inadequate access to foods, to safe water and to health care services (Gopalan, 2000; Peña and Bacallao, 2002).

Investigating the association of residence and SES with child nutritional status within Africa is of special importance since the continent is not on target to reach the first Millennium Development Goal (MDG) of eradicating extreme poverty and hunger by the year 2015. Indeed, actual progress in nutritional well-being continues to bypass many African countries and population subgroups. Recent data indicate that whereas malnutrition among preschoolers is substantially decreasing in Asia and Latin America and the Caribbean, it is on the rise in some countries of SSA, whilst in many others it remains disturbingly high, or is declining only sluggishly (De Onis et al., 2002). It is thus of special interest to identify the population subgroups that policy makers and governments in SSA should target in order to increase the likelihood of meeting the MDGs.

The rest of the paper is organized as follows: Section 2 sets out the data, the variable definitions, the methods used, and their merits for achieving the purpose of this study. The main results of the analyses are presented in section 3, followed by a summary and discussion of the main findings in section 4. We conclude in section 5 by addressing the implications of these findings.

2. Data and methods

Data and selected countries

To achieve the objectives of this study, we use quantitative data from the nationally representative Demographic and Health Surveys (DHS) of 15 countries in SSA, including seven from the Western and Central regions and eight from the Eastern and Southern parts, as shown in

Table 1. The selected countries typify rapid urbanization amidst declining economies. Between 1980 and 2000, the proportion of urban population increased from 22.0% to 35.6% in the selected countries as a whole and as a result, the urban population grew by 5.4% per year during the same period, against 3.5% in the developing countries as a whole, as can be noticed in Column (Col.) 3 of Table 1. The fastest growths are recorded in Kenya (7.4%), Tanzania (7.2%) and Mozambique (6.6%), whilst Zambia (2.2%), Chad (4.0%) and Côte d'Ivoire (4.4%) witnessed the slowest increase rates of their urban population.

[Table 1 about here]

In the meantime, gross domestic product (GDP) per capita dropped by 0.7% in the selected countries as a whole (Col. 5), the most marked reductions being in Togo, Zambia, Côte d'Ivoire and Madagascar (1.7-1.9%), whilst improvements were noted in Uganda (+2.1%) and Burkina Faso (1.2%), and to a lesser degree in Mozambique (0.9%) and Chad (0.7%). Similarly, Table 1 shows that per capita food production index rose by an annual rate of 0.5% in the selected countries, against a sharp increase of 1.8% in the developing countries as a whole. In the Eastern & Southern regions, all countries, with the exception of Malawi and Kenya, witnessed a drop in their food production per capita, while in the Central & Western regions, only Togo recorded such a negative trend.

Table 1 moreover illustrates the economic and social diversities of the selected countries with respect to levels of urbanization, per capita GDP and health expenditures, adult literacy rates and overall human development index (HDI[2]) ranking in 2000. Urbanization rates (Col. 2) differ significantly among the selected countries, varying from 12-17% in Uganda, Malawi and Burkina Faso, to close to, or more than, 45% in Cameroon, Nigeria, Ghana and Côte d'Ivoire, for an average of 34% in SSA as a whole. As regards GDP per head (Col. 4), Côte d'Ivoire, Cameroon and Zimbabwe emerge to be the most affluent countries with values higher than $600, while by contrast, Malawi, Mozambique, Tanzania, Chad and Madagascar are the most deprived (less than $250). Based on health expenditures per inhabitant, populations from Zimbabwe ($142), Côte d'Ivoire ($127) and Kenya ($114) appear to be the most favored, whilst their counterparts from Chad, Madagascar, Tanzania, Burkina Faso, Nigeria and Malawi (between $20 and $40) are the most underprivileged. With regard to adult literacy rate, the selected countries display wide

[2] HDI is a composite index based on three dimensions: health (longevity), education (literacy rate), and resource (standard of living). Countries are ranked in decreasing order of human development index (e.g. rank 1 corresponds to the highest human development level).

diversities, with four countries (Burkina Faso, Chad, Mozambique and Côte d'Ivoire) below 50%; six others (Togo, Malawi, Nigeria, Madagascar, Uganda and Ghana) between 55% and 70%; and the five remaining (Tanzania, Cameroon, Zambia, Kenya and Zimbabwe) above 73%. Overall, according to HDI, four countries (Ghana, Zimbabwe, Cameroon and Kenya) can be classified as high-HDI (ranking below 20 out of 48 African countries), six others (Madagascar, Togo, Nigeria, Zambia, Côte d'Ivoire and Tanzania) as middle-HDI (ranking between 20 and 30), and the five remaining (Burkina Faso, Mozambique, Chad, Malawi and Uganda) as low-HDI (ranking 31 and higher). It is worth noting that in each of the above categories of ranking there is almost the same number of countries from either region (Central & Western Africa, and Eastern & Southern Africa). We make no pretence that these countries are representative of the entire SSA, but their number, geographical spread (West, Central, East and Southern Africa) and socioeconomic and cultural diversities constitute a good yardstick and may allow us to draw some robust inferences.

This study mainly focuses on the latest survey carried out in each country, and refers to the very first one for the sake of examining trends in urban-rural differentials. Survey periods are shown in Table 2. From here, we refer to the first and second surveys in each country as DHS-1 and DHS-2, respectively. We restrict the samples to children aged 1-35 months to ensure strict comparability of the data-sets used in the analyses[3]. We also exclude children with missing or inconsistent anthropometric measures. The percentage of number of children omitted from the DHS-1 samples due to missing or inconsistent anthropometric measurements varies from 6% (in Zambia) to 15%-20% (in Burkina Faso, Cameroon, Ghana, Togo and Zimbabwe), and 24% in Nigeria. In the DHS-2 samples, it ranges from 6% (in Zambia) to 15%-18% (in Burkina Faso, Cameroon, Mozambique and Zimbabwe). Importantly, we define community as the sampling clusters.

Dependent variable

Among various growth-monitoring indices, there are three commonly-used anthropometric measures that offer a comprehensive profile of malnutrition: stunting, underweight and wasting, measured by the indices height-for-age, weight-for-age and weight-for-height, respectively (UNICEF, 1998). The present study focuses on stunting (or chronic protein-energy malnutrition),

[3] Some DHS survey under-five year children, while others target children less than 3 years.

which results in young children from recurrent episodes or prolonged periods of nutrition deficiency for calories and/or protein available to the body tissues, or persistent or recurrent ill-health (UNICEF, 1998; Ricci and Becker, 1996). Since height-for-age measure is less sensitive to temporary food shortages, stunting is considered the most reliable indicator of child's nutritional status, especially for the purpose of differentiating socioeconomic conditions within and between countries (Zere and McIntyre, 2003). As recommended by the World Health Organization (WHO), children whose indices fall more than two standard deviations below the median of the NCHS/CDC/WHO reference population are classified as stunted (De Onis et al., 2000).

Central predictor and socioeconomic variables

The second hypothesis of this study is about whether differentials in child undernutrition between urban and rural areas are explained by differences in relevant socioeconomic conditions. Our central predictor variable is urban-rural place of residence. Three key socioeconomic variables defined at both community and family levels are of special interest in this work: maternal education, household wealth, and community SES. Following recent works of Filmer and Pritchett (2001), we build on our previous work (Fotso and Kuate, 2005a) to construct two complementary socioeconomic indexes using principal components analysis: (i) Household wealth index that captures household's possessions, type of drinking water source, toilet facilities and flooring material; and (ii) Community socioeconomic index, defined from the proportion of households having access to clean water and to electricity, as well as the proportion of wage earners and that of educated adults (level of education primary or higher).

Understandably, the community socioeconomic index is designed to represent the broad socio-economic ecology of the surrounding area in which families live. In line with the multilevel nature of the health determinants (Diez-Roux, 2001; Robert, 1999; Duncan et al., 1998; UNICEF, 1990), it is indeed necessary to consider the characteristics of the immediate environment or community where people live, besides the usual rural-urban location of residence and household-level socioeconomic factors. A number of studies have supported the evidence that mother's schooling is a stronger determinant of child welfare (Bicego and Boerma, 1993; Cleland and Ginneken, 1988; Kuate Defo, 1996). Moreover, when education is widespread, it can influence not only the behavior of the woman herself, but can additionally permeate the whole community, transforming the group norms and opening the door to modern health practices (Lalou and Legrand, 1997). This justifies its inclusion in the community socioeconomic factors. The proportion of wage earners, on the other hand, is designed to capture the job opportunities in the community. Overall, these three socioeconomic variables capture both household and community attributes, and, at the household level, distinguish between the purely economic and the social dimensions of SES.

Father's education and mother's occupation are also used in this study. These socioeconomic factors have not always been incorporated in other studies, on the assumption that they usually correlate strongly with household income (Mosley and Chen, 1984). However, a study by Magadi (1997) showed that both variables had independent effects on child nutritional status. In effect, in some societies of the developing world, the husband generally makes decisions regarding fertility, contraception and use of health care services, so that certain behaviors and practices which may affect child health and nutrition depend on the father, and specifically, on his level of education (Fotso and Kuate, 2005b). Place of residence is coded as 0 for urban and 1 for rural; mother's and father's education are coded as no education (reference category), primary, secondary or higher; mother's occupation is coded as not working (reference), working in agriculture, and working elsewhere; and the two constructed indexes are recoded as poorest[4] (bottom 30%), middle (next 40%), and richest[1] (top 30%), with poorest as the reference category.

Control variables

Though the primary goal of the study is to examine urban-rural differentials after including the above five measures of SES, it is important to add control variables that have been shown to be significantly associated with child nutritional status. The control variables used in this study are: (i) at the mother level: age at birth of the index child, marital status, religion, and nutritional status; and (ii) at the child level: current age, sex, low birth weight, antenatal care, place of delivery, age-specific immunization status, birth order and interval, and breast feeding duration.

Statistical methods

This study uses multilevel models to examine differentials in child stunting by location of residence, and to investigate their socioeconomic correlates, controlling for variables at different levels. In effect, DHS data basically form a hierarchical structure with four levels: children nested within mothers, mothers clustered within households, and households, in turn, nested within

[4] These labels are used for expository purposes, and not following a definition of poor and rich.

sampling clusters. As a result, the conventional assumption of independence of observations is no more valid, since units from the same group are expected to be more alike, at least in part because they share a common set of characteristics or have been exposed to a common set of conditions. Multilevel models provide a framework for analysis of such data (Raudenbush and Bryk, 2002; Rasbash et al., 2002; Duncan et al., 1998). Since the number of children per household is below 1.3 in the data, we collapse the child, mother and household levels and carry out two-level (child and community) random intercept logistic regression analyses in each country, according to the following system of equations:

$$\begin{cases} Logit(\pi_{ij}) = \ln\left[\dfrac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_{0j} + \sum_{k=1}^{p}\beta_k x_{ij}^{(k)} + \sum_{l=1}^{q}\delta_l z_j^{(l)} \\ \beta_{0j} = \beta_0 + u_{0j} \end{cases}$$

In this system of equations, i and j refer to the child and community, respectively; π_{ij} is the probability that the child referenced (i, j) is stunted; $x_{ij}^{(k)}$ and $z_j^{(l)}$ are the k^{th} family-level covariate and the l^{th} community-level covariate, respectively; β_{0j} represents the intercept modelled to randomly vary among communities; the β_k and the δ_l represent the regression coefficients of the familial explanatory variables and the community explanatory variables respectively; and u_{0j} is the random community residuals distributed as $N\left(0,\sigma_u^2\right)$ (Rasbash et al., 2002; Goldstein, 1999). Models are fitted using the MLwiN software with Binomial, Predictive Quasi Likelihood (PQL) and second-order linearization procedures (Rasbash et al., 2002).

Methodologically, we achieve the goals of the study through two sets of models. The first set of multivariate analyses pertains to levels and trends in urban-rural differentials in child malnutrition. It uses pooled (DHS-1 and DHS-2) data and defines an interaction term between a dummy variable for the survey period and urban-rural place of residence. The second set of models relates to the extent to which differentials in child undernutrition by place of residence are explained by the SES of households and communities. It uses DHS-2 data and different combinations of the socioeconomic measures and control variables.

3. Results

Table 2 shows the sample characteristics; Figures 1 displays the rural-urban differentials in child malnutrition; Figures 2 to 5 illustrate the relationship between SES and child malnutrition; and

Figure 6 presents the differences in these measures of SES by place of residence. All descriptive statistics are weighted by sampling probabilities. Multivariate analyses are in Table 3, which shows levels, trends and correlates of the differentials in malnutrition by location of residence. Finally, Table 4 presents a ranking of countries according to selected socioeconomic indicators and to levels and trends of urban-rural differentials in child undernutrition. We present the main findings focusing on the second survey (DHS-2) and referring to only DHS-1 when we evaluate change over time.

3.1. Descriptive analyses.

Table 2 shows that undernutrition affects almost 45-50% of children in Madagascar, Zambia and Malawi, and between 30% and 40% in the remaining countries with the exception of Togo, Côte d'Ivoire, Ghana and Zimbabwe where rates vary from nearly 23% to 28%. Over time, the situation has worsened in Cameroon (+3.7% per year[5]), Zambia (+2.1%), Burkina Faso (+1.2%) and Malawi (+0.6%). Only in three countries, Togo (-2.8% annually), Côte d'Ivoire (-2.2%) and Uganda (-1.1%) has malnutrition diminished markedly over time, at a rate which, however, may not allow any reduction in the number of children affected, given the population growth rates, particularly in urban areas. The highest proportion of rural children are in Uganda, Burkina Faso and Malawi (between 86 and 90%), whereas the highest proportion of urban children are in Côte d'Ivoire, Ghana and Nigeria (nearly 32-33%). In many countries, comparing the proportion of urban children in the sample to urbanization rates in Table 1 (Col. 2) yields some discrepancies. In those instances, the lower proportion of urban children in the analysis sample may be a reflection of generally lower fertility in urban than rural areas. With regard to maternal education, Table 2 shows a very high proportion of uneducated mothers in Burkina Faso (about 90%), Chad (77%), Côte d'Ivoire (65%) and Togo (59%). The figure for Côte d'Ivoire is quite striking given its socioeconomic development. At the other end of the scale, Zimbabwe (7%), and to a lesser extent Zambia, Kenya and Madagascar (nearly 15-20%), have the lowest female illiteracy rates in our sample. This ranking is almost in line with that from adult literacy displayed in Col. 8 of Table 1.

[Table 2 about here]

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[5] The rate of change of an indicator from period 1 to period 2 is calculated as $\left(\frac{X_2}{X_1}\right)^{1/n} - 1$; where X_1 and X_2 are the values of the indicator in the first and second surveys, respectively (23.4% and 30.1 in the case of Cameroon), and n is the time interval in years, between the two surveys (7 years in the case of Cameroon).

Figure 1 shows that rural to urban odds ratio of stunting are above 1.0 in all countries and periods, indicating that rural children are worse off than their urban counterparts. Urban-rural differences are the highest in Tanzania (3.0), Malawi (2.1), and Burkina Faso (1.9), and the lowest in Madagascar (1.2) and Zimbabwe (1.4). As regards change over time, the urban advantage has significantly narrowed in Côte d'Ivoire (-8.2% per year), Zimbabwe (-5.7%), Madagascar (-4.0) and Cameroon (-3.7%), to a lesser degree, in Uganda (-3.2%) and Zambia (-2.2%). By contrast, urban-rural differentials widened sharply in Tanzania (12.5% annually) and slightly in Malawi (+1.8%) and Ghana (1.6%).

[Figures 1 to 6 about here]

Figures 2 to 5 pertain to the association between child undernutrition and community SES, household wealth, maternal education, and father's education, respectively. To a large extent, they exhibit remarkable socioeconomic gradients irrespective of the measure of SES and the country, as rates of malnutrition generally decline steadily with increasing SES. The few exceptions are Madagascar (for maternal education and community SES), and to a lesser degree, Burkina Faso and Ghana (with regard to maternal education). The relationship of father's education and child malnutrition is also weaker in Kenya, Madagascar, Zambia and Zimbabwe. The strength of the association between these four measures of SES and child malnutrition is reflected by the correlation coefficients, which are statistically significant at the level of 0.10, except for maternal education in Côte d'Ivoire and Tanzania, and father's education and community SES in Madagascar (not shown).

Furthermore, it is useful to relate the urban health advantage illustrated in Figure 1 to differences across urban and rural areas in SES. Figure 6 shows rural-urban differentials in the SES of households and communities. More specifically, it indicates urban to rural ratios in the likelihood of communities being among the richest 30% (series 1), of households being among the richest 30% (series 2), and of mothers being educated at the secondary level or higher (series 3). As can be seen, these differences are gigantic for community SES, they are very wide for household wealth, and are rather moderate for maternal education.

3.2. Levels and trends of urban-rural differentials in child malnutrition

This study hypothesizes that the urban advantage in child health has narrowed over time. As can be seen in Table 3, the estimates of change over time in urban-rural differentials conform to expectations in eight countries (out of the thirteen). Marked declines are recorded in Madagascar and Côte d'Ivoire (almost -11% annually), Zimbabwe (-8.8%), Cameroon (-6.1%), Uganda and Zambia (close to -4.5%). Estimates demonstrate statistical significance only in Zimbabwe ($p<0.01$) and Uganda ($p<0.05$), whereas in Madagascar, the sharp decline between the two surveys led to non-statistically significant urban-rural differentials in the second survey period (1997). Urban-rural differentials in child malnutrition also diminished, though less noticeably, in Togo and Burkina Faso (nearly -0.5% annually). Contradicting our initial hypothesis, the urban advantage in child malnutrition significantly widened over time in Tanzania (+9.7% per year), in Ghana (+3.6%) and in Malawi (+2.7%). Estimates of change over time demonstrate statistical significance only in Tanzania. Differentials in child undernutrition by location of residence are also contrary to expectation in Nigeria and Kenya, even though the rates of drop are far less notable (+0.4% and +1.3% per year, respectively).

[Table 3 about here]

Model 1 in Table 3 displays the levels of urban-rural differentials in the DHS-2. The estimates are positive in all countries and statistically significant at the level of 0.01 (except in Madagascar, as mentioned earlier). As expected, the larger urban-rural gaps in malnutrition are to be found in countries with an upward trend (Tanzania, Ghana and Malawi) and in Mozambique, and the lowest ones are observed in countries with a downward trend (Madagascar, Zimbabwe, Zambia, and Côte d'Ivoire).

3.3. What explains rural-urban differentials in child malnutrition?

Of considerable interest to this study (our second hypothesis), is the extent to which underlying differences across urban and rural areas in the SES of communities and families shape the urban-rural gaps displayed in Model 1. For instance, lower undernutrition rates in urban areas may reflect, in part, the child health advantages conferred by mother's schooling or higher household economic situation. We investigate this possibility by examining the extent of reduction of urban advantage in child stunting when we control for different combinations of the socioeconomic measures. Models 2 to 4 present residual urban-rural differentials when community SES, household wealth and mother's education are progressively adjusted for. Model 5 further includes father's education and mother's occupation, and the final parsimonious Model 6 adds all covariates to Model 5 and allows us, when urban-rural differentials persist, to further examine whether they are explained by bio-demographic factors. Interaction of urban-rural residence with household wealth was also included in Model 7 (not shown), to provide some insight of how the urban poor fare compared to other sub-groups. Estimates did reach statistical significance only in very few instances.

Controlling for community SES (Model 2) produces dramatic drop of urban-rural gaps ranging from 35%-40% in Tanzania, Malawi, Chad and Ghana to more than 80% in Uganda, Cameroon and Togo. In Côte d'Ivoire, the estimates reversed signs following a reduction of 140%, suggesting that urban children tend to run greater risk of stunting than their rural counterparts (results not statistically significant). Urban-rural differentials in child malnutrition now demonstrate statistical significance only in Chad and Ghana ($p<0.05$), and in Malawi and Tanzania ($p<0.01$). Model 3 includes household wealth, which results in further drop of urban-rural differentials to loss of statistical significance, except in Malawi ($p<0.05$), following reduction in Chad (-18%), Ghana (-35%) and Tanzania (-50%). Note that in Zimbabwe and Cameroon, estimates turn negative, and that in Côte d'Ivoire, the urban-rural gap is negatively larger, without, however, reaching statistical significance. Adding maternal education (Model 4) and then father's education and mother's occupation (Model 5) produces little change in the estimates of urban-rural differentials. Overall, when all five measures of SES are adjusted for (Model 5), residual urban-rural gaps in child malnutrition reach statistical significance only in Malawi; they are negligible in nine countries (Burkina Faso, Cameroon, Nigeria, Togo, Kenya, Madagascar, Mozambique, Uganda and Zambia); they are non-negligible, non-significant and in the expected direction in three countries (Chad, Ghana, and Tanzania); and non-negligible, non-significant and negative in Côte d'Ivoire and Zimbabwe. Finally, we investigate in Model 6 the extent to which residual differences in Malawi are accounted for by bio-demographic variables at the mother or child levels. Little change is recorded in Malawi, suggesting that undernutrition may be intrinsically lower in cities than in rural areas.

4. Summary and discussion

This work has contemplated the possibility that the urban advantage over the country-side in child health is diminishing or even disappearing, following the urban population explosion amidst stagnating or declining economies in most countries in SSA, and the resultant growing urban poverty. Furthermore, it investigates the extent to which this urban advantage is fully accounted for by the SES of communities and families. A summary of some of the results in terms of ranking is displayed in Table 4. Ranking according to urban population growth (Col. 1) and urban-rural differentials (Col. 5) is in decreasing order, so that rank 1 for Kenya and

Tanzania, respectively, indicates that the former had the highest urban population growth rate, and the latter the largest urban-rural gap in child malnutrition. Ranking according to variation of GDP (Col. 2), of food production (Col. 3), and of urban-rural differentials (Col. 4) is in increasing order, so that rank 1 indicates the fastest decline. Overall, a number of conclusions may be drawn from this study.

Trends in urban-rural differentials

Our data suggest that differentials in child malnutrition by place of residence have substantially narrowed over time in Madagascar, to the extent that urban malnutrition rates are indistinguishable from rural ones in 1997. This trend in urban-rural differentials is primarily due to a sharp increase in urban malnutrition by almost 1.8% per year. Though the country is not among those with the highest urban population growth rates in our sample (4.6% in Table 1, and ranking 12 in Col. 1 of Table 4), it should be noted that Madagascar has one of the highest decline rates of per capita GDP (-1.7% and ranking 4), and the highest rate of decline in food production (-1.3% and ranking 1). While these arguments are, in themselves, insufficient to explain why Madagascar is the only country in our sample to exhibit no differences in child malnutrition by place of residence in the DHS-2, they do support such results.

[Table 4 about here]

Similarly, our results on trends in urban-rural differentials conform to expectations in seven other countries, with sharp decline in Zimbabwe, Uganda, Cameroon, Zambia and Côte d'Ivoire, and moderate drop in Burkina Faso and Togo. Estimates for change over time reached statistical significance only in Zimbabwe and Uganda. These trends were mainly due to a marked increase in urban malnutrition, except in Uganda where they resulted primarily from a decline in rural malnutrition. The fact that, as in the case of Madagascar, these countries are not among those with the highest urban population growth rates -Zambia is even the country with the lowest rate of urban growth (2.2% and ranking 15)- lends support to the view expressed at the conference on human settlements (UNCHS, 1996) that problems of cities are not merely results of size of growth, but primarily pertain to urban management efficiency, economic performances, and similar factors. Table 4 indeed shows that Zambia and Zimbabwe have higher rates of decline in food production and/or GDP, and that Cameroon and Côte d'Ivoire are among the countries with the faster declines in GDP. For these countries, it is generally suggested that the urban advantages in child health have eroded as a consequence of growing urban poverty, resulting from an urban population explosion mainly fueled by migration from rural to urban areas, in the context of economic decline or slowdown (APHRC, 2002; Brockerhoff and Brennan 1998).

We observe that the magnitude of urban-rural differences has moderately changed over time in four countries, namely Burkina Faso and Togo (slight decline), and Kenya and Nigeria (slight increase). Whilst urban and rural malnutrition were almost unchanged over time in Kenya and Nigeria, they both increased in Burkina Faso and both declined markedly in Togo. It is striking to note that, unlike the six countries with sharp declining urban-rural gaps, these ones have higher urban population growth as they are ranked between 1st and 6th (except Togo, ranked 9th). They, however, fared relatively well in food production with positive variations, except in Togo (-0.5%), and to a lesser extent in GDP with ranking 7 and higher for three of them (Kenya, Malawi and Burkina Faso). This finding reinforces the contention that the problems of cities are not merely a consequence of population growth, but are mainly a consequence of commitment and capabilities of municipal and national governments to undertake and sustain policies that improve the wellbeing of the populations (Brockerhoff and Brennan, 1998; UNCHS, 1996).

More surprisingly, our results show that urban-rural differences have dramatically widened in Tanzania due to a dramatic fall in urban malnutrition by 7.6% per year, and to a lesser extent in Ghana, as a result of a decline (-1.4% per year) in urban malnutrition. Malawi also witnessed a widening urban advantage in child malnutrition over time. This result is particularly contrary to expectation, especially in Tanzania, which has experienced the fastest urban population growth (7.2% and ranking 2) and a sharp decline in food production (-1.3% and ranking 2). GDP per capita is, however, on the rise (0.5% and ranking 11). Features in Ghana are to a large extent different, since the country had the lowest urban explosion (behind Zambia), and had enjoyed an increase of food production and GDP.

Investigating the reasons behind the widening gap observed in these countries is beyond the scope of this work. Overall, nonetheless, our results on the comparison across countries have provided a useful picture of the magnitude of change over time in urban-rural differentials in child undernutrition in SSA.

Magnitude of urban-rural gaps in child malnutrition

Our data indicate that urban-rural differentials in child stunting are considerable in all countries (with the exception of Madagascar in the DHS-2, as noted above), and the excess is always in the expected direction, with the largest gaps in Tanzania, Ghana, Mozambique and Malawi. The ranking of Tanzania and Ghana is not surprising since they are the only countries which have experienced a widening over time in the urban-rural differences. Mozambique, having carried out only one survey, could not be assessed for change over time. Though it has higher urban population growth (6.6% and ranking 3) and has witnessed a decline in food production (-0.6% and ranking 5), it recorded a positive GDP growth rate (+0.9%). One may conjecture that this overall economic performance explains, at least in part, the higher level of urban advantage in health. At the other end of the scale, Zimbabwe, Zambia, Uganda and Chad have the narrowest urban-rural gap in child health (if we exclude Madagascar). This was expected since they exhibited faster decline of rural-urban differentials in child malnutrition (ranking 3-6 in Col. 4 of Table 4).

Conflicting results on urban-rural differentials in child malnutrition were reported by Smith et al. (2005). Using DHS data of developing countries, including some of those used in this paper, and a continuous definition of stunting, they found that urban-rural differentials were statistically significant at the level of 0.01 in Madagascar. This may be due, among other reasons, to their definition of stunting on a continuous scale and their analytical strategy. Arguably, defining undernutrition in a dichotomous way as most studies have done (De Onis, 2000; Madise, 1999; Adair and Guilkey, 1997) is more appealing and allows straightforward interpretation of results. One limitation of our results on the ranking of countries, according to the magnitude of urban-rural differentials relates to the variation of the survey dates, from 1996/1997 (Chad, Madagascar and Mozambique) to 2003 (Ghana, Nigeria, Kenya). Since urban-rural gaps in health are hypothesized to be evolving as a result of urbanization and other areas of socioeconomic development, the ranking of countries should ideally be assessed within the same time period.

Socioeconomic correlates of urban-rural differentials

Our results clearly show that the urban advantage in child health evaporates in all countries except Malawi once the SES of families and communities are accounted for, suggesting that the independent relationship between SES and child malnutrition largely accounts for the differences in child malnutrition by location of residence (Kawachi et al., 2002). It is worth noting that

Malawi has narrower urban-rural differentials in the SES of households and communities (see Figure 6). The statistically significant residual gap in Malawi persisted after controls for the mother- and child-level measured covariates. At this stage where all the measured covariates have been adjusted for, we can forward the hypothesis that contextual effects are at work in Malawi, or, stated in other words, that these residual differences arise from differences in urban or rural settings per se (Diez-Roux, 2001; Senior et al., 2000; Duncan et al., 1998; Kawachi et al., 2002). This explanation, while plausible, cannot be considered as definitive since other community correlates not measured or not measurable, such as food availability, agricultural and climate characteristics, air pollution, and epidemiologic data, may account for these residual differences in child undernutrition across rural and urban areas. The fact that the community-level variance demonstrates statistical significance ($p<0.01$) is supportive of the possible effect of unobserved community factors.

Most studies in the field of child malnutrition have shown that differences across rural and urban areas persist after controlling for SES and other covariates in almost all the datasets used (Smith et al., 2005; Menon et al., 2000; Madise et al., 1999; Tharakan and Suchindran, 1999; Adair and Guilkey, 1997). In contrast to these findings, our work suggests that to a considerable degree, urban-rural differentials in child health are accounted for by differences in the distribution of socioeconomic conditions, a result which is consistent with our previous work (Fotso & Kuate, 2005b). This probably relates to a stronger explanatory power of our standardized socioeconomic measures defined at both household and community levels.

As in other studies on urban/rural differentials, a major problem in these analyses revolves around the classification of localities as urban or rural. Some countries classify in terms of administrative boundaries; and others in terms of agglomerations, that is, taking into account the physical structure. Other criteria used include population size, population density, percentage of labor force in non-agricultural activities, or a combination of several of these criteria. And even for those which classify in terms of population size, the minimum size required for a locality to be classified as urban varies from one country to another, for example 5,000 in Ghana, against 20,000 in Nigeria (United Nations, 1985). Though this variety of urban/rural classifications undoubtedly weakens any cross-country comparisons, a uniform definition cannot capture the large variety of urban and rural situations across countries with wide disparities in terms of economic and social development, as those used in this study.

5. Conclusion

During the last two decades, most major cities, not only in SSA, but in the rest of the developing world, have experienced an unprecedented urban population explosion in a context of economic decline or slowdown with consequences in terms of growing urban poverty. This study has shown that differentials in child malnutrition by place of residence have substantially narrowed in six countries (out of 13), due primarily to an increase in urban malnutrition; they have scarcely changed in four countries; and they have widened in three countries as a result of sharp decline in urban malnutrition. Our results also showed that urban-rural differentials are considerable and in the expected direction in all countries, indicating that child malnutrition is lower in urban than rural areas. More importantly, using standardized measures of SES defined at the household and community levels, this study shows that these urban-rural gaps are abolished in almost all countries when community SES, household wealth and maternal education are controlled. The inclusion of father's education and mother's occupation did not significantly alter these results.

Many studies on socioeconomic inequalities in health have shown evidence of higher heterogeneity of urban areas compared to rural settings, with the former harboring pockets of severe poverty and deprivation, and exhibiting substantial concentrations of ill-health among the poor (Zere and McIntyre, 2003; Menon et al., 2000; Haddad et al., 1999; Tim and Lush, 1995). Together with findings from these other works, the results of our study suggest, therefore, that policies and programs contributing to the attainment of the MDGs on child health should pay particular attention to the urban poor. To this end, existing data collection programs, such as the DHS and other nationally representative surveys, should be re-designed to capture the changing patterns of the spatial distribution of population. Indeed, these programs usually exclude the slum areas since they are considered illegal settlements, and when they are included, the sample size is often too small to allow any reasonable slum-specific estimates.

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