J.biosoc.Sci, (2006) **38**, 289–313, © 2005 Cambridge University Press
doi:10.1017/S0021932005026143 First published online 1 June 2005

HOUSEHOLD AND COMMUNITY SOCIOECONOMIC INFLUENCES ON EARLY CHILDHOOD MALNUTRITION IN AFRICA

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Summary. This paper uses multilevel modelling and Demographic and Health Survey data from five African countries to investigate the relative contributions of compositional and contextual effects of socioeconomic status and place of residence in perpetuating differences in the prevalence of malnutrition among children in Africa. It finds that community clustering of childhood malnutrition is accounted for by contextual effects over and above likely compositional effects, that urban–rural differentials are mainly explained by the socioeconomic status of communities and households, that childhood malnutrition occurs more frequently among children from poorer households and/or poorer communities and that living in deprived communities has an independent effect in some instances. This study also reveals that socioeconomic inequalities in childhood malnutrition are more pronounced in urban centres than in rural areas.

Introduction

Nutritional deficiencies and poor health of children are major public health concerns in developing countries, where they represent both a cause and a manifestation of poverty (ACC/SCN, 1997; World Bank, 2003). The short and long term consequences of childhood malnutrition are well documented and include increased susceptibility to infection and risk of mortality, poor functional outcomes such as impaired cognitive or delayed mental development and subsequently poor school performance and reduced intellectual achievement, and poor productivity and work efficiency in adulthood (De Onis *et al*., 2000; Wagstaff & Watanabe, 2000). Ultimately malnutrition hinders human capital, which is one of the most fundamental assets of households, communities and nations. As a result, impoverished disempowered women who were malnourished as infants are more likely to grow up within similar environments throughout their lifecycle and subsequently give birth to malnourished infants, thereby perpetuating the inter-generational effects of malnourishment and the cyclical nature of poverty (ACC/SCN, 1997; World Bank, 2002a, 2003; Haddad *et al.*, 2002).

Poverty also affects child malnutrition, which is often the result of a long sequence of interlinked events ascribed to a wide range of biological, social, cultural and economic factors (Scrimshaw & SanGiovanni, 1997; Gopalan, 2000). In developing countries, such events are usually part of the so-called 'poverty syndrome' with its synergistic attributes of low family income, large family size, poor education, poor environment and housing, poor access to or inequitable distribution within the country of safe water and health care services, and inadequate access to (and availability of) food or inequitable distribution of food available within the country (FAO, 1997; Peña & Bacallao, 2002). Poverty is, however, more than the lack of income or assets, since factors, some of which are captured by the concept of 'capability', also influence a child's nutritional status. This dimension of what has been defined as human poverty encompasses the household's opportunities within society (ACC/SCN, 1997; Haddad *et al.*, 2002). Overall, prominent among factors influencing child nutritional status are the socioeconomic ones (Oakes & Rossi, 2003). Indeed a large body of health research in developing countries has incorporated a measure of socioeconomic status (SES) (Liberatos *et al.*, 1998), and documented an inverse relationship between SES and a variety of health outcomes over time and space, regardless of the measure of the SES. Existing evidence lends support to the view that people privileged by more education, higher income, the dominant ethnicity, higher status jobs and better housing standards have better health than their less privileged counterparts (Cebu Study Team, 1991; Ruel *et al.*, 1992; Ricci & Becker, 1996; Adair & Guilkey, 1997; Ruel *et al.*, 1999; Kuate-Defo, 2001; Rajaram *et al.*, 2003).

Yet little is known about inequalities in childhood malnutrition between socioeconomic groups in developing countries and especially in Africa (Alvarez-Dardet, 2000; Kuate-Defo, 2001). It is therefore important to investigate the extent to which such inequalities have varied over time and to address the issue of urban–rural differentials in those inequalities. Besides 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 (Ruel *et al.*, 1992; Ricci & Becker, 1996; Madise *et al.*, 1999; Tharakan & Suchindran, 1999). Assessing the socioeconomic influences on child nutritional status both between and within developing countries has special appeal for policy and programmes targeted at improving the well-being and survival chances of children. Unfortunately, the literature on these topics has been growing asymmetrically, the body of knowledge being built mainly on evidence from industrialized countries (Alvarez-Dardet, 2000). This gap is most glaring in the case of comparative and nationally representative studies of child malnutrition. More importantly, in the absence of standard measures of the SES of families and communities, researchers have typically used their own indicators, making cross-study comparisons difficult. Furthermore, these indicators may measure slightly different dimensions of SES, leading to different classifications of poverty and subsequently to the identification and selection of different population groups (Glewwe & van der Gaag, 1990). Additionally, the modelling strategies of these investigations often ignore the multilevel nature of influences on child nutritional status and the hierarchical structure of the data used.

It is against this background that this study is designed in an attempt to investigate how the contexts and socioeconomic conditions of families and communities of residence influence the nutritional status of children over time and space. Specifically, the objectives of this paper are to: (i) assess the extent of clustering of childhood malnutrition among communities and what factors account for it; (ii) examine levels and trends in urban–rural differentials in childhood malnutrition, and whether they are influenced by the SES of communities and households; and (iii) investigate the magnitude and changes over time in the influences of the SES of families and communities on child's nutritional status and the extent to which they interact with urban–rural residence to produce substantively different expressions of inequalities in the prevalence of childhood malnutrition.

Conceptual framework

UNICEF's (1990) and Mosley and Chen's (1984) frameworks both constitute a milestone in the sphere of research on determinants of child health in developing countries (Cebu Study Team, 1991; Robert, 1999) and are used in this study to articulate the relationships between household (the term household is used interchangeably with family in this paper) and community socioeconomic factors and child malnutrition in Africa. It is posited that socioeconomic factors operate at different levels (e.g. community, household, family) through more proximate determinants that in turn influence the risks and the outcomes of malnutrition.

According to these frameworks, a child's welfare (morbid status, nutritional status, immunity status and survival status) is largely determined by five groups of proximate risk and protective factors: (i) the child's characteristics, prominent among which are biological variables such as age, sex, birth weight, gestational length, health conditions at birth, and birth order; (ii) the mother's reproductive patterns and cultural practices, encompassing age at puberty, age at sexual debut, age at maternity, birth spacing practices, religious affiliation and religiosity, and exposure to media; (iii) the mother's nutritional behaviour and status proxied by breast-feeding patterns and body mass index; (iv) the access to and utilization of health care services, especially for antenatal care, delivery and immunization of children; and (v) the household size and composition that may be measured by both the total number of its members and especially those under five years of age as well as the gender composition of the household. There is an extensive literature documenting the potential effects of these factors on child health (Ricci & Becker, 1996; Adair & Guilkey, 1997; Ruel *et al.*, 1999; Kuate-Defo, 2001).

Socioeconomic family-level variables encompass parents' education and employment, household's income and ownership of consumer durable goods, water, sanitation and housing. Parental education usually correlates strongly with parental occupation and often serves as a proxy for a household's assets and marketable commodities the household consumes. Mother's education and occupation can affect a child's health by influencing her choices, increasing her skills and improving behaviours related to preventive care, nutrition, hygiene, breast-feeding, parity and birth intervals (Mosley & Chen, 1984). Typically, inadequate or improper education of women often exacerbates their inability to generate resources for improved nutrition for their families (UNICEF, 1990). A number of studies have supported that mother's schooling is a stronger determinant of child welfare, but have also shown some inconsistencies about the magnitude and significance of its effects compared with those of other socioeconomic indicators such as income or wealth (Cleland & van Ginneken, 1988; Ruel *et al*., 1992).

The household's socioeconomic factors mainly influence its member's health through the income and wealth effects. In the absence of reliable information on income, many indicators may capture the household's financial ability to secure goods and services that promote better health, help to maintain a more hygienic environment and ensure adequate nutritional needs. For example, inaccessibility to clean water and poor environmental sanitation increase the prevalence of both malnutrition and disease. Inadequate access to water may also affect nutrition indirectly by increasing the work-load on mothers and thus reducing the time available for child care (Mosley & Chen, 1984; UNICEF, 1990; Kuate-Defo, 2001).

Community-level covariates include availability of health-related services and relevant socioeconomic infrastructures. Community socioeconomic factors may influence child health and nutrition through two major pathways: by shaping the family/household-level SES, and/or by directly affecting the social, economic and physical environments shared by residents, which in turn operate through more proximate attributes to impact health outcomes (Robert, 1999). Public services such as electricity, water, sewerage, transportation and telephone networks are likely to be quite inadequate in lower socioeconomic communities with often deleterious consequences on child's health. Similarly, the existence and quality of, and access to, health-related services usually differ by socioeconomic characteristics of communities. Even where these basic services and foods are available in deprived areas, their access may be hampered by barriers such as inadequate or unsafe transportation systems (Mosley & Chen, 1984).

Despite the overwhelming interest and progress on SES in health research, its conceptualization or measurement remain unsettled (Campbell & Parker, 1983; Alder *et al*., 1993; Lynch & Kaplan, 2000). Cortinovis *et al*. (1993) have also stressed the need to construct overall socioeconomic indexes rather than using individual indicators. There is still no consensus on its nominal definition or on a widely accepted measurement tool (Campbell & Parker, 1983; Cortinovis *et al*., 1993; Oakes & Rossi, 2003). In this context, researchers working on developing countries often use their own individual-, household- or community-level socioeconomic indicators, thus making cross-national comparisons virtually impossible. Moreover, since different SES indicators may be correlated with one another, their use in the same statistical model is usually called into question with arguments invoking problems of multicollinearity, instability of estimated parameters and their interpretation (Campbell & Parker, 1983; Alder *et al*., 1993). The ignorance of father's education is also a shortcoming of current approaches since in many settings of the developing world, the husband generally takes decision regarding fertility, contraception and use of health care services, so that certain behaviours and practices which may affect child health and nutrition depend on the father and specifically on his level of education (Kuate-Defo & Diallo, 2002). In addition, the distribution of the paternal education is generally more heterogeneous than maternal education particularly within rural areas, thus increasing the likelihood of a statistically significant relationship with child nutritional status.

Methods

This study uses data from Demographic and Health Surveys (DHS) in the following five African countries that carried out more than one DHS in the 1990s: Burkina Faso (1992/93, 1998/99); Cameroon (1991, 1998); Egypt (1992, 2000); Kenya (1993, 1998); and Zimbabwe (1994, 1999). The DHS have comparable, renowned good quality information on community and household characteristics as well as on nutrition and health of women aged 15–49 years and their children born within three to five years before the survey date. The samples were restricted to children aged 3–36 months to ensure strict comparability of the datasets used in the analyses. Children were excluded whose mother was not resident in the household surveyed. Table 1 displays the sample sizes as well as the hierarchical distribution of the number of units at different levels (child, mother, household, community).

The selected countries exhibit quite different socioeconomic and demographic profiles. Burkina Faso is one of the least developed countries, while Egypt by contrast is one of the most affluent. Real Gross Domestic Product (GDP) *per capita* varied from almost $US250 in Burkina Faso to $US1230 in Egypt, with intermediate values close to $US330 in Kenya, $US625 in Zimbabwe and $US665 in Cameroon (World Bank, 2002b). According to the Human Development Index (HDI), Egypt is ranked position 7 (out of a total of 48 African countries); Zimbabwe, Kenya and Cameroon are in the middle class, ranking 14th, 17th and 18th, respectively; and Burkina Faso lags behind at the 45th position, just before Mozambique, Burundi, Niger and Sierra Leone (UNDP, 2002). The selection of Burkina Faso furthermore introduces a dimension of extreme poverty and poor infrastructural development that characterizes a number of sub-Saharan African countries. Hence, although the selected countries are not representative of the entire African continent, their geographic location (West, Central, North, East and Southern Africa) and socioeconomic and cultural diversities constitute a good yardstick for the continent.

Focusing on the relationship between nutritional status and SES within Africa is of special importance. In effect, the African continent is not on target to reach the first Millennium Development Goal of eradicating extreme poverty and hunger by the year 2015. Despite the success of the World Summit for Children (1990), the International Conference on Nutrition (1992) and the World Food Summit (1996) in achieving their primary goal (i.e. to arouse interest and commitment in policies, programmes and activities aimed at improving the nutritional status of populations), actual progress in nutritional well-being continues to bypass many African countries and population subgroups. Indeed, malnutrition rates among preschool children are on the rise in some countries, whilst in many others, they remain disturbingly high or are declining only sluggishly, with very low prospects of significant improvement. Between 1990 and 2000, the overall prevalence of stunting among preschool children in Africa has diminished by only 2·5 percentage points (from 37·8% to 35·2%), and the absolute number of malnourished children has risen by almost 13·5% (from 41·7 to 47·3 million). Eastern Africa witnessed an increase of nearly 29% (from 17·1 to

Table 1. Hierarchical distribution of the number of units at each potential level of analysis

	Burkina Faso		Cameroon		Egypt		Kenya		Zimbabwe	
	1993	1999	1991	1998	1992	2000	1993	1998	1994	1999
Communities	76	75	76	76	74	84	83	85	70	70
Households	2172	2171	1270	1489	3442	4988	2565	2530	1716	1564
Mothers	2582	2611	1445	1669	3673	5258	2674	2622	1812	1637
Children[a] aged 3–36 months	2688	2730	1619	1816	4134	5873	3013	2907	1927	1714
Children per mother	1·0	1·0	1·1	1·1	1·1	1·1	1·1	1·1	1·1	1·0
Mothers per household	1·2	1·2	1·1	1·1	1·1	1·1	1·0	1·0	1·1	1·0
Children per household	1·2	1·3	1·3	1·2	1·2	1·2	1·2	1·1	1·1	1·1
Household per community	28·6	28·9	16·7	19·6	46·5	59·4	30·9	29·8	24·5	22·3
Children per community	35·4	36·4	21·3	23·9	55·9	69·9	36·3	34·2	27·5	24·5

[a]Children whose mother is not resident of the household surveyed are excluded from analyses.

22 millions) of undernourished children during this period (De Onis *et al.*, 2000). The ever worsening political climate in most sub-Saharan African regions resulting in wars and refugee problems as well as the restricted inflow of foreign capital investments have tilted the economies downwards with an unprecedented hardship on populations, especially on children as they are more prone to suffer from nutritional deficiencies than adults because they are physiologically more vulnerable (Tharakan & Suchindran, 1999; World Bank, 2003).

An important issue in studies dealing with area effects on health is the definition of 'communities' or 'neighbourhoods' or, more precisely, the geographic area whose characteristics are thought to be relevant to the health outcome under study. Most health-based studies in developing countries using community-level characteristics rely on sampling cluster as proxy for community, and very few have provided a concise definition of community. Conceptually, the size and definition of community may vary according to the processes through which area effect is hypothesized to operate and to the health outcome studied. For example, areas based on administrative boundaries may be relevant when hypothesized processes involve public policy; whereas geographically defined neighbourhoods may be relevant when physical environment is supposed to be the most important (Diez-Roux, 2001). Nevertheless, researchers working with national representative samples often have no choice but to rely on administrative definitions for which standard data are available, even though these structures may have no explicit theoretical justification in terms of the outcome being studied (Duncan *et al.*, 1998). This study defines community by grouping sampling clusters within administrative units in order to have a desirable minimum number of communities and number of households per community in each urban and rural sample.

Dependent variable

Among various growth-monitoring indexes, there are three commonly used comprehensive profiles of malnutrition in children, namely stunting, wasting and underweight, measured by height-for-age, weight-for-height and weight-for-age indexes respectively. Stunting, or growth retardation, or chronic protein–energy malnutrition (PEM) occurs in young children as a result of recurrent episodes or prolonged periods of nutrition deficiency for calories and/or protein available to the body tissues, inadequate intake of food over a long period of time, or persistent or recurrent ill-health. Wasting or acute PEM captures the failure to receive adequate nutrition during the period immediately before the survey, resulting from recent episodes of illness and diarrhoea in particular, or from acute food shortage. Underweight status is a composite of the two preceding ones, and can be due to either chronic or acute PEM (Kuate-Defo, 2001). As recommended by the World Health Organization (WHO), children whose index is more than two standard deviations below the median NCHS/CDC/WHO reference population are classified as malnourished, that is stunted, wasted or underweight depending on the index used.

In this paper stunting is used as an indicator of child's nutritional status. From a pragmatic perspective, it is not relevant to focus on wasting since it is generally of very low prevalence. In the datasets, for example, the prevalence of wasting in four of the five countries and two periods ranged from 3·0% to 7·5% against a range of 20·4–34·0% for stunting. This relatively low level of wasting limits the extent to which it can be used as an indicator of malnutrition, since much larger samples are required to explore the correlates of this outcome. Moreover, a number of studies have shown that wasting is particularly sensitive to seasonal fluctuations of food availability and exposure to infectious diseases, and is often insensitive to prevailing socioeconomic conditions, exhibiting insignificant socioeconomic differentials, and unable to manifest the steep gradients related to SES as observed with stunting (World Bank, 2002b; Zere & McIntyre, 2003). Although being underweight often parallels stunting, seasonal weight recovery and some children being overweight can also affect the weight-for-age index. In contrast, the height-for-age measure is less sensitive to temporary food shortages, and thus stunting is considered the most reliable indicator of a child's nutritional status, especially for the purpose of differentiating socioeconomic conditions within and between countries (Zere & McIntyre, 2003).

Key independent variables

Four key independent variables are of interest in this study and are defined in Appendix Table 1A. They are place of residence (urban or rural), household wealth index, household social status and community endowment status. Following recent work by Filmer & Pritchett (2001) and Gwatkin *et al*. (2000) and the conceptual framework presented above that recognizes the distinctive feature of socioeconomic indexes measured at the household versus community levels, three relevant and complementary socioeconomic indexes are constructed using principal component analysis: (i) Household wealth index, which captures a household's possessions, type of drinking water source, toilet facilities and flooring material, and thus embodies or may be used as a proxy for the commonly used income or expenditures variables; (ii) Household social index, which encompasses maternal and paternal educational level and occupation; and (iii) Community endowment index or simply community SES, defined from the proportion of households having access to electricity, telephone and clean water, together with relevant community-level information retrieved from community surveys when available. These community-level variables include accessibility of roads, availability of a sewerage system and availability of or distance to health services, pharmacy and other socioeconomic infrastructures such as schools, markets, transportation services, banks and postal services. In the descriptive analyses, the three indexes are assigned to five 20% quintiles classified as poorest (bottom 20%), low (next 20%), middle (next 20%), high (next 20%) and richest (top 20%). In the multivariate analyses, these socioeconomic indexes are treated as continuous and centred variables.

In a previous study (Fotso & Kuate-Defo, in press), it has been shown that each of these socioeconomic indexes is internally coherent, in that it produces sharp separations across its quintile groups for each of the indicators used in its construction, indicating their high degree of summarizing information contained in the asset variables. The explanatory power of the indexes was then evaluated on various health outcomes including health care services utilization (antenatal care, immunization), malnutrition (stunting, underweight) and mortality (infant mortality, under-five mortality). The association generally exhibited remarkable socioeconomic gradients in each of the five selected countries and survey periods.

Control variables

Control variables used include: (i) at the household level, the number of household members and the number of under-five children (both continuous centred variables), and their quadratic term; (ii) at the mother level, religion, exposure to media such as radio and television, current age, teenage childbearing and nutritional status; and (iii) at the child level, current age, sex, low birth weight, antenatal care, place of delivery, age-specific immunization status, breast-feeding duration, birth order and birth interval. Appendix Table 1A summarizes the description of variables used in this study.

Statistical methods

Descriptive analyses are used to portray the association between each socioeconomic index and childhood malnutrition by place of residence. To deepen the urban–rural differences in stunting by SES gradient, this paper calculates concentration index according to the following formulae presented by Kakwani *et al.* (1997):

$$\begin{cases} C = \dfrac{2}{n\mu}\displaystyle\sum_{i=1}^{n} y_i R_j - 1 \\[2ex] \mathrm{Var}\,(C)\,\dfrac{1}{n}\left[\dfrac{1}{n}\displaystyle\sum_{i=1}^{n} a_i^2 - (1+C)^2\right] \\[2ex] a_i = \dfrac{y_i}{\mu}(2R_i - 1 - C) + 2 - q_{i-1} - q_i \end{cases} \tag{1}$$

where C is the concentration index; n is the sample size; y_i refers to the outcome variable (stunting); R_i is the relative rank of individual i according to his socioeconomic status; μ is the mean of y; and q_i is the cumulative proportion of y:

$$q_i = \frac{1}{n}\sum_{k=1}^{i} y_k.$$

The concentration curve plots the cumulative proportions of the population (beginning with the most disadvantaged) against the cumulative proportion of health outcome. The resulting concentration index, which is similar to the Gini coefficient, varies from -1 to $+1$, and measures the extent to which a health outcome is unequally distributed across groups. The closer the index is to zero, the less unequally distributed among socioeconomic groups is the health outcome. The sign of the index reflects the expected direction of the relationship between the SES and the health outcome (Wagstaff *et al.*, 1991; Gwatkin *et al.*, 2000).

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For multivariate analyses, this study uses multilevel models to investigate the effects of context and to quantify the influences of SES on early childhood malnutrition, controlling for variables at different levels. In effect, in the social and biomedical sciences, cross-sectional data usually have a hierarchical structure due mainly to random sampling of naturally occurring groups in the population. As a result, observations 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, thus violating the standard assumption of independence of observations inherent to conventional regression models. Consequently, unless some allowance for clustering is made, standard statistical methods for analysing such data are no longer valid, as they generally produce downwardly biased variance estimates, leading for example to inference of the existence of an effect when in fact that effect estimated from the sample could be ascribed to chance (Rasbash *et al.*, 2002). Furthermore, to gain a more complete understanding of the influences of SES on child malnutrition, the child, mother, household and community levels need to be considered simultaneously. This requirement, however, poses technical difficulties for traditional statistical modelling techniques as they operate only at a single level. By simultaneously modelling the effects of group- and individual-level predictors, with individuals as units of analysis, multilevel models also permit the disentangling of contextual effects from compositional ones (Goldstein, 1999; Snijders & Bosker, 1999).

DHS data basically form a hierarchical structure with four levels: children nested within mothers at level 2; mothers clustered within households at level 3; and households in turn nested within communities at level 4. However, with an average of 1·1 children aged 3–36 months per mother, and almost 1·2 children per household in the datasets (see Table 1), a family level is defined by collapsing child-, mother- and household-level data. Two-level logistic regression analyses are then carried out in each country and period according to the following system of equations:

$$\begin{cases} \text{Logit}\,(\pi_{ij}) = \ln\left[\dfrac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_{0j} + \sum_{k=1}^{p} \beta_k x_{ij}^{(k)} + \sum_{l=1}^{q} \delta_l z_j^{(l)} \\ \beta_{0j} = \beta_0 + u_{0j} \end{cases} \qquad (2)$$

where i and j refer to the family and community respectively; π_{ij} is the probability that 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; β_k and δ_l represent the regression coefficients of the familial and the community explanatory variables respectively; and u_{0j} is the random community level residuals distributed as $N(0,\sigma_u^2)$ (Goldstein, 1999; Snijders & Bosker, 1999; Rasbash *et al.*, 2002). Models are fitted using the MLwiN software with Binomial, Predictive Quasi Likelihood (PQL) and second-order linearization procedures (Goldstein, 1999; Rasbash *et al.*, 2002). Finally, changes over time are assessed by comparing the coefficients for the two survey periods. Calculation of the standard deviation of change is based on the assumption of independence of the DHS-1 and DHS-2 samples in each country. This may not be the case strictly speaking, since some households may be selected in both samples.

Table 2. Prevalence[a] of stunting among children[b] aged 3–36 months by place of residence, and poor/rich ratios[c] according to household and community socioeconomic status

	Burkina Faso		Cameroon		Egypt		Kenya		Zimbabwe	
	1993	1999	1991	1998	1992	2000	1993	1998	1994	1999
Prevalence										
Overall	31·3	34·0	25·4	31·7	29·5	20·4	33·0	33·0	23·5	29·3
Urban	20·7	22·7	16·5	24·4	23·4	15·2	23·8	24·4	18·6	24·2
Rural	33·1	35·5	31·2	34·5	33·0	23·6	34·1	34·8	25·1	31·6
Rural/urban ratio	1·6	1·6	1·9	1·4	1·4	1·6	1·4	1·4	1·4	1·3
Poor/rich ratio										
Household wealth index	1·5	1·5	3·2	2·3	1·8	2·0	2·1	2·5	1·8	2·2
Household social index	1·6	1·2	2·4	1·7	1·8	1·1	1·9	2·4	2·2	1·5
Community endowment index	1·9	1·6	3·0	1·7	1·7	2·4	1·5	1·8	2·1	1·4

[a]Weighted by sampling probabilities.
[b]Children whose mother is not resident of the household surveyed are excluded from analyses.
[c]Ratio between the rate of malnutrition prevailing in the poorest 20% population quintile and that found in the richest 20% quintile.

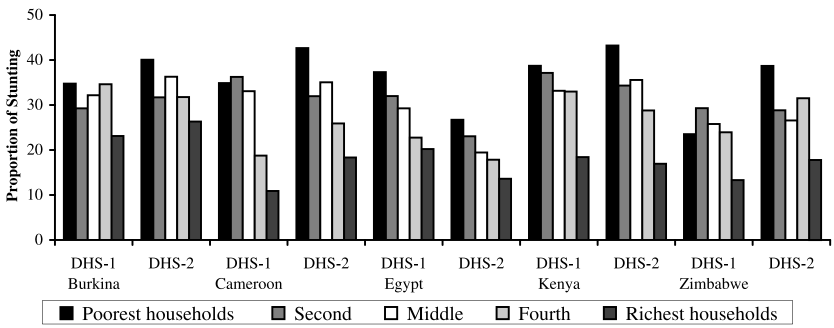

Fig. 1. Household wealth status and early childhood malnutrition.

Results

The descriptive results are shown in Table 2 and Figs 1–3, whilst the multivariate analyses are displayed in Tables 3–5. The main findings emerging from these results are presented focusing primarily on the first survey (DHS-1) and reference is made to the DHS-2 when assessing change over time in the magnitude and significance of effects of covariates.

Descriptive analyses

Table 2 displays the prevalence of stunting in the five countries and at two points in time. Irrespective of the country and the survey year, chronic malnutrition is highly

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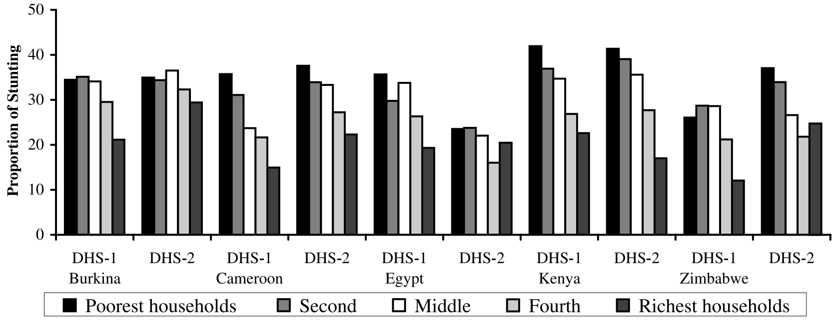

Fig. 2. Household social status and early childhood malnutrition.

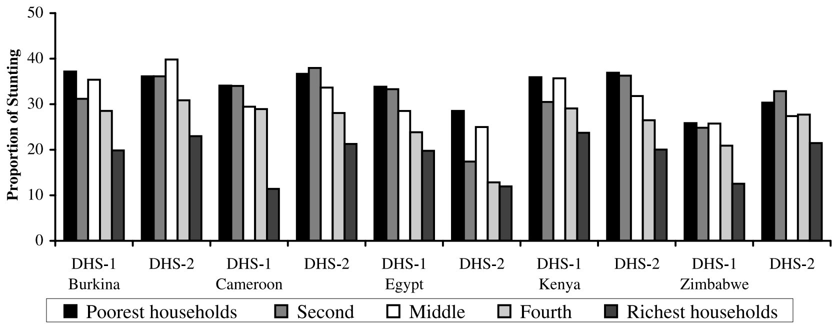

Fig. 3. Community socioeconomic status and early childhood malnutrition.

prevalent and affects between 20·4% (Egypt, 2000) and 34·0% (Burkina Faso, 1999) of children aged 3–35 months. Furthermore, the nutritional status of children has substantially deteriorated during the inter-survey period in Zimbabwe and Cameroon by almost 25%, and to a lesser degree in Burkina Faso by 9%, corresponding to an average annual increase of 4·5%, 3·2% and 1·4% respectively. In contrast, the nutritional status of children in Egypt continues to improve consistently over time nationwide, with a drop in malnutrition rate by almost 31% (or 4·5% on an annual basis). Between these two extremes, malnutrition rate has remained unchanged in Kenya. Urban–rural differentials in childhood malnutrition are also apparent. As expected for all countries and over time, the prevalence of childhood malnutrition is higher in rural areas than in urban centres, with rural/urban ratios of 1·9 in Cameroon, 1·6 in Burkina Faso and almost 1·4 in the three other countries. This urban advantage has somewhat diminished over time, particularly in Cameroon, where the prevalence of stunting increased substantially by almost 48% as compared with an increase of 10% amongst their rural counterparts.

In general the three socioeconomic indexes indicate that the poorest segment of the population has the highest prevalence of malnutrition in all countries and over time whereas its richest counterpart has the lowest prevalence. Figures 1–3 illustrate this general pattern of prevalence of stunting among children by socioeconomic quintile groups. The prevalence of stunting generally declines steadily with increasing

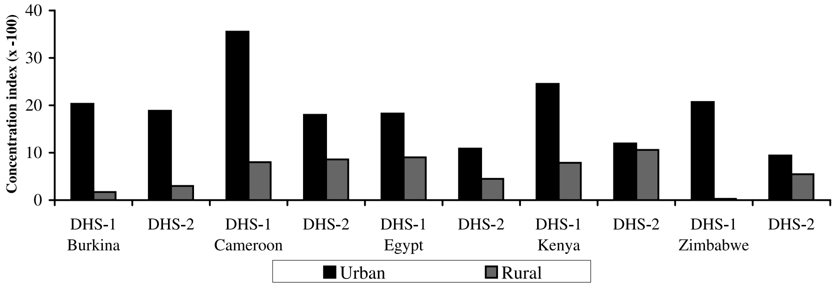

Fig. 4. Household wealth inequalities in child malnutrition by place of residence. The concentration index for ill-health, varying typically between 0 and − 1, has been multiplied by − 100 in order to yield values between 0 and 100 in Tables 4–6.

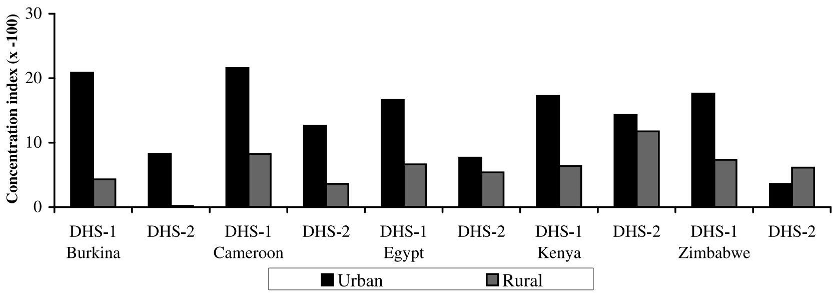

Fig. 5. Household social inequalities in child malnutrition by place of residence.

SES. To portray this pattern further, the poor/rich ratio is used in Table 2 to assess the general order of magnitude of differences between the poorest and the richest groups of the population. Cameroon has the highest poor/rich ratio for the household wealth index, with children from the poorest SES group having an almost 3·2 times greater chance of being stunted than their counterparts in the richest SES group, followed by Kenya (2·1), Egypt and Zimbabwe (1·8) and Burkina Faso (1·5). The poor/rich ratio for the household social index ranges from almost 1·6 in Burkina Faso to nearly 2·3 in Cameroon and Zimbabwe. Finally, the bivariate association between community endowment index and child nutrition shows that children from communities in the poorest SES group are almost 3·0 times more likely in Cameroon, and 2·1 times more likely in Zimbabwe to be stunted, than their counterparts in the most privileged communities.

Whether socioeconomic inequalities vary significantly by place of residence is further assessed. Figures 4–6 display the magnitude of inequalities in urban versus rural areas using a concentration index. The estimates are higher in urban centres than in rural areas, regardless of the country, the measure of SES and the survey date. The only exceptions are noted in Zimbabwe (1999) for household social index and in Kenya (1993) for community SES. In the former case, the urban coefficient is not statistically significant at the level of 0.10 whilst in the latter both urban and rural coefficients fail to reach statistical significance.

https://doi.org/10.1017/S0021932005026143 Published online by Cambridge University Press

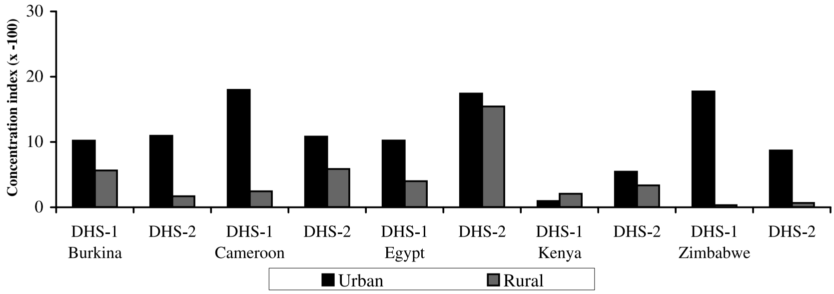

Fig. 6. Community socioeconomic inequalities in child malnutrition by place of residence.

Variability in child stunting among communities

Panel A of Table 3 displays estimates of the variability in malnutrition among children across families and communities, with and without accounting for measured covariates. Community-level random variations are significantly different from zero in all countries and survey periods ($p<0{\cdot}01$), suggesting apparent variability among communities in early childhood stunting (Model a). The intra-community correlation (ICC), which measures the proportion of the total variance which is between communities (Pebley *et al*., 1996; Snijders & Bosker, 1999), is more than 17% in Cameroon, and almost or less than 5% in the four other countries. The ICC comparing Model b with Model a indicates that compositional effects explain a large amount of the variation in Cameroon (34%), in Egypt (28%) and in Zimbabwe (20%). In Burkina Faso and Kenya compositional effects explain less than 4% of the variation among communities. A significant variation between communities remains in all countries ($p<0{\cdot}05$ in Zimbabwe, $p<0{\cdot}01$ in the two other countries). It is therefore clear that differences among communities with regard to childhood malnutrition cannot be explained simply by familial socioeconomic and demographic factors.

Whether this variability is explained by community characteristics such as urban–rural residence and community SES is examined in Model c. Variability in child stunting among communities further decreases in Zimbabwe and Burkina Faso, indicating that the place of residence and the SES of the community account for almost 7% of the contextual effects in childhood malnutrition. In the three other countries, including community covariates slightly increased the contextual effects by 3% to 7%.

Urban–rural differentials in childhood malnutrition

The second objective of this study is to evaluate urban–rural differentials in childhood malnutrition and the extent to which they are explained by the SES of communities and families. Converting estimates in Panel B of Table 3 into odds ratios indicates that malnutrition rates in rural areas are almost 2·6 times higher in Cameroon, nearly 90% higher in Burkina Faso and close to 60% higher in Egypt and Kenya, and Zimbabwe, than in cities (Model a). Controlling for community endowment index (Model d) shows that the SES of communities explains between 32% and

Table 3. Estimates (coefficients) of the variation among communities and families, and the urban–rural differentials in childhood malnutrition

	Burkina Faso		Cameroon		Egypt		Kenya		Zimbabwe	
	1993	1999	1991	1998	1992	2000	1993	1998	1994	1999
Panel A: Variation (coefficients) among communities and families in childhood malnutrition										
Model a: Without covariates										
σ^2_{u0}	0·111***	0·125***	0·687***	0·291***	0·176***	0·457***	0·157***	0·184***	0·169***	0·225***
ICC[a]	3·3%	3·7%	17·3%	8·1%	5·1%	12·2%	4·6%	5·3%	4·9%	6·4%
Model b: Controls for household wealth index, household social index, and other household, mother and child covariates[b]										
σ^2_{u0}	0·107**	0·126***	0·42***	0·233***	0·126***	0·379***	0·152***	0·102**	0·135**	0·189***
ICC	3·1%	3·7%	11·4%	6·6%	3·7%	10·3%	4·4%	3·0%	3·9%	5·4%
Model c: Expands Model b by adding urban–rural residence and community endowment index										
σ^2_{u0}	0·100**	0·124***	0·436***	0·242***	0·135***	0·368***	0·158***	0·117**	0·124**	0·182***
ICC	2·9%	3·6%	11·7%	6·9%	3·9%	10·1%	4·6%	3·4%	3·6%	5·2%
Panel B: Urban–rural differentials (coefficients) in childhood malnutrition										
Model a: Without covariates										
Rural residence	0·642***	0·659***	0·963***	0·579***	0·502***	0·537***	0·466**	0·419***	0·456**	0·376*
Model b: Controls for household wealth index										
Rural residence	0·350***	0·227	0·213	0·023	0·263**	0·420	−0·150	−0·210	−0·218	−0·170
Model c: Controls for household social index										
Rural residence	0·318*	0·703***	0·699***	0·435**	0·316***	0·462***	0·111	0·139	0·178	0·101
Model d: Controls for community endowment index										
Rural residence	0·418***	0·656	0·438	0·027	0·306	0·278	0·318	0·001	0·226	−0·001
Model e: Controls for both household wealth and social indexes										
Rural residence	0·173	0·312	0·189	0·032	0·206	0·396**	−0·280	−0·255	−0·311	−0·315
Model f: Controls for community endowment index and household wealth and social indexes										
Rural residence	0·033	0·656	0·009	−0·050	0·157	0·224	−0·221	−0·105	−0·294	−0·379
Model g: Expands Model f by adding the other household, mother and child covariates										
Rural residence	0·031	0·879	−0·140	0·120	0·003	0·152	−0·088	−0·164	−0·431	−0·362

*$p<0{\cdot}10$; **$p<0{\cdot}05$; ***$p<0{\cdot}01$.
[a]Intra-community correlation.
σ^2_{u0} is the estimated coefficient for community-level random variation: statistical testing is about the hypothesis $\sigma^2_{u0}=0$·
[b]The other covariates include (i) at the household level: the number of members and the number of under-five children, and their quadratic term; (ii) at the mother level: religion, exposure to media, current age, teenage first childbearing and nutritional status; and (iii) at the child level: current age, sex, low birth weight, antenatal care, place of delivery, age-specific immunization status, breast-feeding duration and birth order/interval.

39% of urban–rural differentials in Kenya, Burkina Faso and Egypt, and more than 50% in Cameroon and Zimbabwe, with a loss of statistical significance at the level of 0·10 in all countries except in Burkina Faso. Similar effects are noted for the household wealth index (Model b) and the household social index (Model c). Model e reveals that both household wealth and household social statuses explain much urban–rural differentials, as urban malnutrition rates are now indistinguishable from rural ones at the level of 0·10 in all countries and periods except in Egypt (2000). Controlling for the three socioeconomic indexes (Model f) further reduces estimates to loss of statistical significance in all countries and periods, indicating that urban–rural differentials in child malnutrition are mainly accounted for by household and community SES. However, it is possible that some proportion of the rural–urban differentials could be attributed to selective migration rather than simply to an outcome effect of household or community SES. In Kenya and Zimbabwe, estimates are turned negative (though not statistically significant at the level of 10%), indicating that children from rural areas may tend to have better nutritional status than their counterparts in urban centres when SES is adjusted for. Finally, adjusting for the household, mother and child covariates change only marginally the magnitude of the difference between urban and rural likelihood of malnutrition in the selected countries.

Gross estimates of socioeconomic influences on child malnutrition

Table 4 shows the multilevel estimates of each socioeconomic indicator fitted alone (Models a, b and c) and of the two household indexes fitted simultaneously (Model d). The third hypothesis of this work is about the inverse relationship between prevalence of child nutritional status and the SES of families and communities. As hypothesized, there is a strong inverse relationship between each of the three socioeconomic measures and child stunting, with statistically significant estimates in virtually all countries. Moreover, adding interaction with place of residence (sub-Model (3) in Models a to d) clearly indicates that socioeconomic inequalities in childhood malnutrition are consistently higher in urban centres than in rural areas. The coefficients, however, fail to reach statistical significance in Kenya for community SES (Model c), and in some instances in Model d.

Concerning the household wealth status (Model a), a control for the place of residence produces impact in line with expectations in Burkina Faso, Egypt and Cameroon where estimates diminish by 28%, 14% and 7% respectively. In contrast, the effects of household wealth status on child's nutritional status are markedly on the rise in Zimbabwe (by 19%) and to a lesser degree in Kenya (7%). During the inter-survey period, wealth inequalities in child health tended to narrow in Cameroon, Egypt and Zimbabwe, and were somewhat on the rise in Burkina Faso and Kenya, without reaching statistical significance.

When place of residence is taken into account, the effects of household social status (Model b) on childhood stunting diminish sharply in Cameroon and Burkina Faso and slightly in the three other countries, but remain statistically significant ($p<0{\cdot}05$ in Burkina Faso, $p<0{\cdot}01$ in the other countries). Moreover, during the inter-survey period, inequalities in child health with respect to household social status have almost disappeared in Burkina Faso ($p<0{\cdot}05$), have narrowed in

Table 4. Estimates (coefficients) of the gross socioeconomic effects on childhood malnutrition

	Burkina Faso			Cameroon			Egypt			Kenya			Zimbabwe		
	1993	1999	Change	1991	1998	Change	1992	2000	Change	1993	1998	Change	1994	1999	Change
Model a: Estimated effects (coefficients) of the household wealth index															
(1) HH wealth[a]	− 0·308***	− 0·313***	− 0·01	− 0·649***	− 0·431***	0·22**	− 0·257***	− 0·160***	0·10	− 0·403***	− 0·540***	− 0·14	− 0·345***	− 0·319***	0·03
(2) HH wealth	− 0·223***	− 0·261***	− 0·04	− 0·603***	− 0·427***	0·18	− 0·222***	− 0·144***	0·08	− 0·430***	− 0·587***	-0·16	− 0·411***	− 0·373***	0·04
(3) HH wealth	− 0·374***	− 0·230***		− 0·631***	− 0·410***		− 0·227***	− 0·184*		− 0·432***	− 0·332**		− 0·836***	− 0·197	
(3) HH wealth: rural[b]	0·339**	− 0·109		0·075	− 0·030		0·007	0·050		0·002	− 0·546		0·691***	− 0·302	
Model b: Estimated effects (coefficients) of the househod social index															
(1) HH social[c]	− 0·299***	− 0·083*	0·22**	− 0·342***	− 0·197***	0·15	− 0·237***	− 0·123***	0·11*	− 0·315***	− 0·379***	− 0·06	− 0·255***	− 0·243***	0·01
(2) HH social	− 0·232**	0·026	0·26**	− 0·257***	− 0·135**	0·12	− 0·206***	− 0·108**	0·10	− 0·307***	− 0·369***	− 0·06	− 0·228***	− 0·226***	0·00
(3) HH social	− 0·522***	− 0·201		− 0·436***	− 0·219*		− 0·249**	− 0·123		− 0·398**	− 0·433***		− 0·406*	− 0·206	
(3) HH social: rural[d]	0·395***	0·273**		0·262	0·103		0·062	0·020		0·099	0·074		0·215	− 0·024	
Model c: Estimated effects (coefficients) of the community endowment index															
(1) Com SES[e]	− 0·241***	− 0·256***	− 0·02	− 0·461***	− 0·291***	0·17	− 0·232***	− 0·235**	0·00	− 0·203**	− 0·259***	− 0·06	− 0·224**	− 0·214**	0·01
(2) Com SES	− 0·135*	− 0·002	0·13	− 0·311**	− 0·281**	0·03	− 0·122	− 0·161	− 0·04	− 0·085	− 0·259	− 0·17	− 0·127	− 0·216	− 0·09
(3) Com SES	− 0·675***	− 0·023		− 1·624***	− 0·244**		− 0·934***	− 1·096***		− 0·045	− 0·085		− 1·565**	− 0·687	
(3) Com SES: rural[f]	0·552**	0·387		1·453***	− 0·093		0·857***	0·985***		− 0·046	− 0·558		1·539**	0·782	
Model d: Estimated effects (coefficients) of the household wealth and social indexes															
(1) HH wealth	− 0·188**	− 0·339***	− 0·15	− 0·610***	− 0·439***	0·17	− 0·177***	− 0·133***	0·04	− 0·272***	− 0·374***	-0·10	− 0·257***	− 0·230**	0·03
(1) HH social	− 0·212**	0·046	0·26***	− 0·069	0·015	0·08	− 0·153***	− 0·070	0·08	− 0·241***	− 0·274***	− 0·03	− 0·156*	− 0·165***	− 0·01
(2) HH wealth	-0·160**	− 0·282***	− 0·12	− 0·577***	− 0·434***	0·14	− 0·154***	− 0·121***	0·03	− 0·318***	− 0·426***	− 0·11	− 0·342***	− 0·318**	0·02
(2) HH social	-0·188*	0·074	0·26**	− 0·056	0·017	0·07	− 0·142***	− 0·061	0·08	− 0·248***	− 0·278***	− 0·03	− 0·169**	− 0·186***	− 0·02
(3) HH wealth	− 0·250***	− 0·220***		− 0·587***	− 0·402***		− 0·120	− 0·156		− 0·379**	− 0·233		− 0·784***	− 0·166	
(3) HH social	− 0·391***	− 0·035		− 0·115	− 0·029		− 0·213*	− 0·065		− 0·240	− 0·299*		− 0·151	− 0·170	
(3) HH wealth: rural	0·267*	− 0·144		0·055	− 0·056		− 0·050	0·042		0·095	− 0·434**		0·724***	− 0·266	
(3) HH social: rural	0·260*	0·126		0·078	0·061		0·105	0·006		− 0·012	0·043		− 0·032	− 0·015	

*$p<0{\cdot}10$; **$p<0{\cdot}05$; ***$p<0{\cdot}01$.
(1) Without controls; (2) Controls for urban–rural residence; (3) Adds interaction between socioeconomic index and urban–rural residence.
[a]Household wealth index; [b]Interaction between household wealth index and place of residence; [c]Household social index; [d]Interaction between household social index and place of residence; [e]Community endowment index; [f]Interaction between community endowment index and place of residence.

Egypt and Cameroon, but have tended to widen in Kenya. When the effects of both household wealth and household social standings are considered simultaneously (Model d), they are statistically significant in all countries except in Cameroon where the household social status has no significant influence on child health. The effects of the wealth status are slightly larger than those of the social status in all countries except in Burkina Faso. This finding adds to the debate on whether health inequalities among families primarily result from the effects of material hardship, or mainly reflect disparities with regard to social position, measured in this paper by mother's and father's education and occupation (Lynch & Kaplan, 2000).

With regard to the community SES (Model c), controlling for the location of residence sharply reduces the estimates between 33% (Cameroon) and 60% (Kenya), leading to loss of statistical significance in Egypt, Kenya and Zimbabwe. Though estimates for change fail to reach statistical significance, community socioeconomic inequalities have tended to widen during the inter-survey period in Kenya, Zimbabwe and Egypt.

Net effects of household and socioeconomic influences on child malnutrition

Table 5 presents estimates of the influences of the three socioeconomic indexes taken together on childhood malnutrition with control for place of residence (Model a), household/mother attributes (Model b), child characteristics (Model c), and interaction effects between socioeconomic indexes and place of residence (Model d, not shown). In Model a, household wealth and household social statuses exhibit a statistically significant inverse relationship with child's nutritional status in Burkina Faso, Egypt, Kenya and Zimbabwe, whereas only household wealth status reaches statistical significance in Cameroon ($p<0{\cdot}01$). Adjustment for household/mother attributes (Model b) produces striking features. Whilst the effects of the household social status vary in the expected direction with a drop of 20% in Egypt, and a slight decrease by less than 7% in Burkina Faso, Kenya and Zimbabwe, the effects of the household wealth situation are substantially on the rise by 15–25% in all countries, except in Kenya where they diminish by 20%.

When child characteristics are added to the estimated equation (Model c), some significant variations in the socioeconomic effects are noticed. The community socioeconomic effects increase sharply in Burkina Faso to reach statistical significance ($p<0{\cdot}10$); household wealth estimates are on the rise in Burkina Faso whereas they decrease by 18–24% in Cameroon, Egypt and Kenya, and by 5% in Zimbabwe. The effects of household social status further decline in all countries leading to a loss of statistical significance except in Kenya. Overall, household-, mother- and child-level controls contribute on the one hand to an increase in the household wealth effects in Burkina Faso and Zimbabwe by 30% and 16% respectively, and on the other hand to a drop in Kenya by 35% and Egypt by 8%. The household social effects diminish markedly in Zimbabwe by almost 60%, Egypt by nearly 40%, Burkina Faso by 28% and Kenya by 12%. Consequently, the relative contributions of the three socioeconomic measures and particularly the prominence of the household wealth index on child nutritional status become clear. Three patterns now emerge: household wealth status alone in Cameroon and Zimbabwe ($p<0{\cdot}01$); household wealth and social

Table 5. Estimates (coefficients) of the net socioeconomic effects on childhood malnutrition

	Burkina Faso			Cameroon			Egypt			Kenya			Zimbabwe		
	1993	1999	Change	1991	1998	Change	1992	2000	Change	1993	1998	Change	1994	1999	Change
Model a: Without controls															
HH wealth[a]	−0·150**	−0·301***	−0·15	−0·563***	−0·426***	0·14	−0·151***	−0·113**	0·04	−0·321***	−0·441***	−0·12	−0·343***	-0·314**	0·03
HH social[c]	−0·181*	0·072	0·25**	−0·048	0·019	0·07	−0·142***	−0·061	0·08	−0·249***	−0·279***	−0·03	−0·169**	−0·187***	−0·02
Com SES[e]	−0·098	0·171	0·27	−0·122	−0·049	0·07	−0·034	−0·110	−0·08	0·037	0·105	0·07	0·010	−0·040	−0·05
Rural residence	0·033	0·656	0·62	0·009	−0·050	−0·06	0·157	0·224	0·07	−0·221	−0·105	0·12	−0·294	−0·379	−0·09
Model b: Controls for household and mother covariates[1]															
HH wealth	−0·173**	−0·307***	−0·13	−0·699***	−0·374***	0·33**	−0·184**	−0·108*	0·08	−0·254**	−0·378***	−0·12	−0·419***	−0·356*	0·06
HH social	−0·170*	0·073	0·24**	−0·024	0·007	0·03	−0·114**	−0·047	0·07	−0·231***	−0·254***	−0·02	−0·160*	−0·181**	−0·02
Com SES	−0·095	0·152	0·25	−0·145	−0·037	0·11	−0·014	−0·110	−0·10	0·039	0·054	0·02	0·033	0·022	−0·01
Rural residence	0·014	0·598	0·58	−0·183	−0·012	0·17	0·103	0·199	0·10	−0·170	−0·079	0·09	−0·430	−0·348	0·08
Model c: Expands Model b by adding child covariates[2]															
HH wealth	−0·195**	−0·322***	−0·13	−0·576***	−0·311***	0·27*	−0·139	−0·088	0·05	−0·209**	−0·308**	−0·10	−0·399***	−0·356*	0·04
HH social	−0·131	0·071	0·20*	0·010	0·033	0·02	−0·084	−0·034	0·05	−0·219***	−0·222***	0·00	−0·069	−0·104	−0·04
Com SES	−0·160*	0·219	0·38	−0·153	0·049	0·20	−0·037	−0·105	−0·07	0·043	0·098	0·06	0·036	0·048	0·01
Rural residence	0·031	0·879	0·85	−0·140	0·120	0·26	0·003	0·152	0·15	−0·088	−0·164	−0·08	−0·431	−0·362	0·07

*p<0·10; **p<0·05; ***p<0·01.

[a, c, e] See Table 3.

[1] At the household level: the number of members and the number of under-five children, and their quadratic term; at the mother level: religion, exposure to media, current age, teenage first childbearing and nutritional status

[2] Current age, sex, low birth weight, antenatal care, place of delivery, age-specific immunization status, breast-feeding duration and birth order/interval.

Note: Model d expanding Model c by adding interactions between each of the three socioeconomic indexes and child age (not shown).

indexes in Kenya (level of significance 0·05 for wealth, 0·01 for social); household wealth index and community SES in Burkina Faso (level of significance 0·05 for wealth, 0·10 for community SES); and none in Egypt.

Converting the estimated socioeconomic coefficients in Model c (Table 5) into odds ratios yields the following results. Malnutrition rates among children from the poorest 30% household wealth group are estimated to be almost 3·5 times higher in Cameroon, and 2·5 times higher in Zimbabwe, than among their counterparts in the richest 30% household wealth group. This poor/rich ratio averages 1·4 in the other countries (Burkina Faso, Egypt and Kenya). As regards household social status, the likelihood of malnutrition among children from the poorest 30% group is 1·6 times higher in Kenya than among those from the richest 30% group. For the community SES, malnutrition rates in Burkina Faso are almost 45% higher among children in deprived communities than among those in the most privileged areas. Moreover, during the inter-survey period, inequalities among communities in child malnutrition have tended to narrow in Cameroon and to widen in Egypt; household wealth inequalities have lowered in Cameroon, Egypt and to a lesser degree in Zimbabwe, and tended to be on the rise in the two other countries; household social inequalities have significantly narrowed in Burkina Faso ($p<0{\cdot}10$).

A Model d was also fitted, which expands Model c by adding interactions between child age (dichotomized as 3–23 months and $\geq$24 months) and each of the three socioeconomic measures (results not shown). No significant interaction term emerged except in Egypt (2000) and Kenya (1998) where the interaction between household wealth index and child age reached statistical significance at the level of 0·01 and 0·05 respectively. Furthermore, the coefficients were negative, indicating higher explanatory power of the household wealth index to predict the nutritional status of children aged 24 months and older in these two countries and time periods.

Discussion

This study has examined the relative contributions of compositional and contextual effects of urban–rural place of residence and socioeconomic status (SES) in explaining malnutrition among children in Africa, using a coherent analytic framework and multilevel modelling approaches. A number of findings emerge from this work.

The gap in the prevalence of child malnutrition between better-off and disadvantaged groups remains wide. The SES of communities and households is significantly associated with childhood stunting, with household wealth emerging as the strongest predictor and the community SES playing in some instances an independent and important role. The socioeconomic situation of individuals and communities affects a broad array of characteristics, conditions and experiences, which in turn are likely to affect their health and nutritional status. The community SES plays a sizeable role in affecting health status, presumably through its influences on the SES of individuals and the social service and physical environment of communities shared by residents (Mosley & Chen, 1984; Cortinovis *et al.*, 1993; Robert, 1999). Although cross-study comparisons are rendered difficult because most previous studies have typically used their own SES indicators, this work yields consistent evidence across countries and over time of better nutritional status among children from parents privileged by more education and better jobs, from wealthier households or from the most affluent areas. The relationships between SES and stunting are weaker in Zimbabwe, especially in the second time period (1999), as can be noted in the descriptive as well as multivariate analyses. However, data on the quality of the constructed socioeconomic indexes as measured through the proportion of variance explained by the first principal component and through the internal coherence (not shown), do not reveal any evidence of poorer adjustment in Zimbabwe (for details, see Fotso & Kuate-Defo, in press).

The strong evidence of variations in child malnutrition among communities is consistent with the presence of contextual and socio-environmental effects. This finding, in line with most studies that attempt to disentangle contextual from compositional effects (Reed *et al.*, 1996; Subramanian *et al.*, 2003), lends support to the growing evidence on the influences of living conditions in health and nutrition research (Alvarez-Dardet, 2000; Pickett & Pearl, 2001). Moreover, including community SES and place of residence in fitted models resulted in an increase in the amount of between-community variance in Cameroon (both periods), Egypt (1992) and Kenya (both periods). It may be conjectured that controlling for urban–rural place of residence and community SES reveals important differences in unmeasured familial characteristics by community of residence that were previously obscured and/or revealed important unmeasured differences among communities. When both individual and area level predictors were entered in the model, the intra-community correlation ranges from nearly 3% in Burkina Faso to almost 12% in Cameroon. The existence of such unobserved heterogeneity suggests that other key community correlates not included in the analyses also significantly influence child nutrition.

This study also confirms the evidence from most previous studies that have consistently reported that urban children are significantly less likely than rural ones to become malnourished (Ricci & Becker, 1996; Adair & Guilkey, 1997; Tharakan & Suchindran, 1999; Kuate-Defo, 2001). Furthermore, it shows that this urban advantage is essentially accounted for by the SES of communities and families, which probably points to a stronger explanatory power of the standardized socioeconomic measures developed and used in this study. Thus, as suggested by Smith *et al.* (2004), better nutritional status of urban children is probably due to the cumulative effects of a series of more favourable socioeconomic conditions, which in turn seems to positively impact on caring practices for children and their mothers. Finally, an assessment of the extent to which differences in nutritional status among children arising from interactions between SES and place of residence consistently indicates that the socioeconomic gradient in child health is steeper in urban centres than in rural areas, or stated in other words, that large differentials exist among socioeconomic groups in urban areas. These patterns also emerged from the works of Menon *et al.* (2000) based on eleven developing countries across Africa, Asia and Latin America, which suggests that reliance on global average statistics to allocate resources between rural and urban areas may be misleading. They are clearly supportive of the advocacy for programmes and policies targeting the nutrition situation of the population living in poor urban areas (Menon *et al.*, 2000), since the African continent is witnessing a rapid urbanization accompanied in most countries by severe economic deceleration, leading to decreased livelihood opportunities, worsening health conditions and growing poverty.

Acknowledgments

This work was carried out as part of the research programme on 'Reproductive Behavior, Population Health and Nutrition in Africa' of the PRONUSTIC Research Laboratory at the University of Montreal. It was supported by research grants from the Mellon Foundation (New York, USA), the Rockefeller Foundation (New York, USA), the Thrasher Research Fund (Utah, USA), the Social Sciences and Humanities Research Council of Canada (SSHRC) (grant No. 410–98–1109) and the *Fonds pour la Formation de Chercheurs et l'Aide à la Recherche* (FCAR) of Quebec, Canada (grant No. 99-NC-1930). Additional support was provided by doctoral fellowships from the Mellon Foundation and the Population Council to Jean-Christophe Fotso.

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Appendix

Table 1A. Definitions and specifications of variables used in analyses

Variable	Operational definition, specification and explanations
Stunting	Dummy variable coded 1 if the child's height measurement in relation to his age is more than 2 standard deviations below the median reference of the WHO/NCHS/CDC[a]
	Panel B: Independent variables (socioeconomic indexes[b])
1. Household wealth index	Constructed from household's ownership of a number of durable goods (electricity, radio, TV, refrigerator, bicycle, motorcycle, car, oven, stove and telephone), type of drinking water source, toilet facilities and flooring material. The latter three indicators are re-coded 0–1 in terms of access to clean water, modern toilets and finished floor respectively.
2. Household social index	Constructed from a set of dummy variables related to mother's and father's education and occupation. Education is coded: 0 (no education); 1 (primary); and 2 (secondary and more). Occupation is coded: 0 (no occupation); 1 (works in the agricultural sector); and 3 (works in the other sectors).
3. Community endowment index	Constructed from the proportion of households having access to electricity, telephone and clean water, along with relevant community-level characteristics such as access roads, sewerage system, distances to different socioeconomic infrastructures (schools, markets, regular transportation services, postal services, banks, health services, pharmacy) when available.
	Panel C: Selected control variables[c]
1. Media exposure	Dummy variable coded 1 if mother has access to radio or television at home.
2. Teenage childbearing	Dummy variable coded 1 if index child's birth occurred before the age of 20 years.
3. Nutritional status of the mother	Dummy variable coded 1 if mother's body mass index (BMI) is less than 18·5, a cut-off recommended for assessing chronic energy deficiency among non-pregnant women.
4. Antenatal care	Dummy variable coded 1 if child's mother received at least one antenatal care from a medically trained person during pregnancy.
4. Place of delivery	Dummy variable coded 1 if the child was delivered in a health centre.
6. Immunization status	Dummy variable coded 1 if the child is fully immunized for his age. The following age schedule was used for infant vaccination derived from the Expanded Program on Immunization set by the WHO[a]: BCG at birth; DPT and oral Polio at 2, 3 and 4 months; Measles at 9 months.
7. Birth order and interval	Combination of birth order and preceding birth interval in five categories: (i) first, (ii) 2^{nd}–3^{rd} and <24 months, (iii) 2^{nd}–3^{rd} and $\geq$24 months, (iv) 4^{th}+ and <24 months, (v) 4^{th}+ and $\geq$24 months.

[a]World Health Organization/National Center for Health Statistics (USA)/Center for Disease Control (USA).

[b]The three socioeconomic indexes are continuous variables. However, when necessary they are categorized according to quintile values.

[c]The other covariates that need no further specification include: (i) at the community level, urban–rural residence; (ii) at the household level, the number of members and the number of under-five children, and their quadratic term; (iii) at the mother level, religion and current age; and (iv) at the child level, current age, sex, low birth weight and breast-feeding duration.