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CHILD NUTRITION IN VULNERABLE POPULATIONS IN EASTERN AND SOUTHERN AFRICA, 2000–2006

Guest Editors: John Mason, Saba Mebrahtu, and Peter Horjus

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Impact of drought and HIV on child nutrition in Eastern and Southern Africa

John B. Mason, Sophie Chotard, Adam Bailes, Saba Mebrahtu and Peter Hailey

Abstract

Background. *Intermittent food insecurity due to drought and the effects of HIV/AIDS affect child nutritional status in sub-Saharan Africa. In Southern Africa in 2001–3 drought and HIV were previously shown to interact to cause substantial deterioration in child nutrition. With additional data available from Southern and Eastern Africa, the size of the effects of drought and HIV on child underweight up to 2006 were estimated.*

Objective. *To determine short- and long-term trends in child malnutrition in Eastern and Southern Africa and how these are affected by drought and HIV.*

Methods. *A secondary epidemiologic analysis was conducted of area-level data derived from national surveys, generally from the mid-1990s to the mid-2000s. Data from countries in the Horn of Africa (Ethiopia, Kenya, and Uganda) and Southern Africa (Lesotho, Malawi, Mozambique, Swaziland, Zambia, and Zimbabwe) were compiled from available survey results. Secondary data were obtained on weight-for-age for preschool children, HIV prevalence data were derived from antenatal clinic surveillance, and food security data were obtained from United Nations sources (Food and Agriculture Organization, International Labour Office, and others).*

Results. *Overall trends in child nutrition are improving as national averages; the improvement is slowed but not stopped by the effects of intermittent droughts. In Southern Africa, the prevalence rates of underweight showed signs of recovery from the 2001–03 crisis. As expected, food production and price indicators were related (although weakly) to changes in malnutrition prevalence; the association was strongest between changes in food production and price indicators and changes in malnutrition prevalence in the following year. Areas of higher HIV prevalence had better nutrition (in both country groups), but this counterintuitive association is removed after controlling for socioeconomic status. In low-HIV areas in Eastern Africa, nutrition deteriorates during drought, with prevalence rates of underweight 5 to 12 percentage points higher than in nondrought periods; less difference was seen in high-HIV areas, in contrast to Southern Africa, where drought and HIV together interact to produce higher prevalence rates of underweight.*

Conclusions. *Despite severe intermittent droughts and the HIV/AIDS epidemic (now declining but still with very high prevalence rates), underlying trends in child underweight are improving when drought is absent: resilience may be better than feared. Preventing effects of drought and HIV could release potential for improvement and, when supported by national nutrition programs, help to accelerate the rates of improvement, now generally averaging around 0.3 percentage points per year, to those needed to meet Millennium Development Goals (0.4 to 0.9 percentage points per year).*

Key words: Africa, drought, HIV, nutrition

Introduction

Intermittent food insecurity from drought and the effects of HIV/AIDS impact nutritional status in sub-Saharan Africa, causing fluctuations in the underlying trends. The direction and size of these underlying trends are sometimes overlooked in the stream of urgent warnings and emergency appeals. This paper aims to assess trends and fluctuations in recent years.

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Since around 1990, several episodes of severe drought have undermined progress, and the HIV/AIDS epidemic has evolved. Broad estimates of nutritional status (using child underweight as the most common indicator of malnutrition) indicated virtually no change from 1990 to 2005 in overall prevalences in Africa [1, 2] and possible increases in Eastern Africa (about 0.3 percentage points per year from 1990 to 2005); this contrasts with all other developing regions, where malnutrition prevalences are falling by an average of around 0.5 percentage points per year.

Assessments of the effects of drought in Southern Africa in 2001–03 (initiated by UNICEF, reported in Mason et al. [3]) found that drought, amplified by HIV/AIDS, caused substantial increases in underweight (but not in wasting), particularly in previously better-off areas. This survey covered Lesotho, Malawi, Mozambique, Swaziland, Zambia, and Zimbabwe. The research reported here, also sponsored by UNICEF in its coordinating role for nutrition, extends the scope to include data from Ethiopia, Kenya, and Uganda (in the Greater Horn of Africa, referred to as "Horn countries") and compares these with the Southern African countries, for which the data have also been updated.

In Southern Africa, areas with higher prevalences of HIV had lower malnutrition prevalences and lower child mortality rates; these associations were hypothesized to be due to higher HIV prevalences in areas that were better off socioeconomically [3]. The association of HIV with higher socioeconomic status was subsequently shown at the household level in the Kenya Demographic and Health Survey (DHS) [4, 5], lending credence to the explanation. The association of HIV with underweight prevalences has now been examined further, in both Southern Africa and in the Horn countries, taking account of socioeconomic status, as reported here.

A concern has been that the HIV/AIDS epidemic is weakening the resilience of households to survive and recover from income and production losses due to drought, leading perhaps to what has been termed a "new variant famine"[6], which is likely to persist after drought recedes. The results from the previous study on Southern Africa did show that drought and HIV interacted so that nutrition deteriorated much faster in areas where both drought and HIV occurred than in areas where only one of these occurred [3]. This finding is revisited here with newer data, and also examined for the Horn countries; preliminary results were reported in Chotard et al. [7]. More recent survey results from Southern Africa indicate whether recovery in nutrition has occurred after the 2001–03 drought.

This paper aims to provide estimates of the underlying trends in child nutrition, to assess the size of the intermittent effects of drought, food insecurity, and HIV, in selected countries in Eastern and Southern Africa.

Methods

Data sources and datasets

The two geographic regions studied are Southern Africa (Lesotho, Malawi, Mozambique, Swaziland, Zambia, and Zimbabwe) and the Greater Horn of Africa (Kenya, Ethiopia, Eritrea, Somalia, Sudan, and Uganda); limited data were available from Eritrea, Sudan, and Swaziland. All data used were at the area (typically province) level, building on the previously constructed datasets for Southern Africa [3] and extending these for the Horn countries. In the working datasets, a case was a nutritional survey result, defined by area (province or equivalent) and time of survey (month and year), with other variables matched to this area and time; separate datasets were created for Southern Africa (based on that used for the analyses given in [3]) and the Horn countries.

Nutritional data

Anthropometric data were obtained from the surveys shown in **table 1**, as the prevalence of underweight children (< −2 SD weight-for-age by World Health Organization [WHO]/National Center for Health Statistics [NCHS] standards—the indicators reported at the time—for children 6 to 59 months of age), defined by province (or equivalent) and time (month and year). The main sources of these data were Demographic and Health Surveys (DHS); Multiple Indicator Cluster Surveys (MICS, sponsored by UNICEF); governmental national surveys, either primarily for nutrition (e.g., Zimbabwe) or including nutrition in broader surveys (e.g., Welfare Monitoring Surveys, Ethiopia); and nongovernmental organization district surveys (Zambia).

Underweight prevalence data were accessed from the datasets themselves in most cases; where the datasets were not available, data from the published reports or WHO database [8] were used, adjusted to 6 to 59 months where needed as described in [3]. DHS datasets and reports were downloaded from the Measure/DHS website [9]. MICS datasets and reports were provided by UNICEF [10]. For Ethiopia, the national Central Statistical Authority Welfare Monitoring Surveys were one source [11]; DHS surveys [12, 13] were also used. The national surveys generally used a two-stage cluster sampling method representative at the provincial level. District-level surveys conducted by nongovernmental organizations in Malawi and Zambia typically used 30 × 30 cluster sampling methodology and are representative at the district level.

HIV data

Prevalence data for HIV were taken from the HIV/AIDS Surveillance Data Base [14] and from Joint

TABLE 1. List of surveys used

Country	Year	Timing (season)	Source
Eritrea	1995		DHS
	2002	Mar–Jul	DHS
	1993–2002		MOH
Ethiopia	1996	Jun–Jul (moderate/hunger)	CSA/WMS
	1998	Jun–Jul (moderate/hunger)	CSA/WMS
	2000	Jun–Jul (moderate/hunger)	CSA/WMS
	2000	Feb–Jun (postharvest/moderate)	DHS
	2004–05	Jan–Feb 05 (postharvest)	CSA/WMS
	2005	Apr–Aug (moderate/hunger)	DHS
Kenya	1998	Mar–May (moderate)	DHS
	2000	Sep–Oct (hunger)	MICS
	2003	May–Jul (moderate/hunger)	DHS
Southern Sudan	2000	Jul–Aug (hunger)	MICS II
Uganda	1995	Mar–Aug (moderate)	DHS
	2000–01	Sep–Feb (postharvest)	DHS
Lesotho	2000	Mar–May (hunger)	UNICEF/MICS
	2002	Oct (moderate)	NNEPI
	2004–05	Sep–Jan (moderate)	DHS
Malawi	1992	Sep–Nov (moderate)	DHS
	1995	Oct (moderate)	UNICEF/MICS
	2000	Jun–Nov (postharvest)	DHS
	2002	Jul–Aug (postharvest)	District surveys: round 1
	2002–03	Dec–Feb (moderate)	District surveys: round 2
	2003	Apr–May (postharvest)	District surveys: round 3
	2004–05	Oct–Jan (moderate)	DHS
	2006	Jul–Nov (postharvest)	DHS
Mozambique	1997	Mar–Jun (hunger/postharvest)	DHS
	2000–01	Oct–May (all seasons)	QUIBB
	2002	Dec (moderate)	VAC2
	2003	May–Jun (postharvest)	VAC3
	2003–04	Jul–Sep (postharvest)	DHS
Swaziland	2000	Aug (postharvest)	UNICEF/MICS
Zambia	1992	Mar (hunger)	DHS
	1996–97	Jul–Jan (postharvest/moderate)	DHS
	1999	Oct (moderate)	UNICEF/MICS
	1999	Oct (moderate)	UNICEF/MICS
	2001–02	Nov–May (moderate/hunger)	DHS
	2002	Jan–May (hunger)	DHS
	2002	Sep–May (moderate/hunger)	District surveys: round 1
	2002–03	Nov–Mar (moderate)	District surveys: round 2
Zimbabwe	1994	Sep (postharvest)	DHS
	1999	Aug–Nov (postharvest)	DHS
	2002	May (postharvest)	National Nutrition Survey
	2003	Jan (moderate)	National Nutrition Survey
	2004–05	Mar, Nov	National Surveillance System

CSA/WMS Welfare Monitoring Survey, by Central Statistics Authority; DHS, Demographic and Health Survey; MICS, Multiple Indicator Cluster Survey; MOH, Ministry of Health; NNEPI, National Nutrition and EPI Cluster Survey; QUIBB, Questionario de Indicadores Basicos de Bem-Estar (Core Welfare Indicator Questionnaire); VAC, Vulnerability Assessment Committee.
Seasonality: 'hunger' refers to the period before the harvest; 'post-harvest' is immediately after the harvest; 'moderate' is between post-harvest and hunger seasons.

United Nations Programme on HIV/AIDS (UNAIDS) reports [15]. The information in the database contains the sentinel surveillance site information from antenatal clinics, as well as data from national reports and scientific publications. The search criterion used in the database was for pregnant women 15 to 49 years of age. For Zambia, HIV prevalence data were also found in the DHS 2001–02 survey. Malawi had data available from the National AIDS Control Programme, via the POLICY Project [16]. Adjustment of HIV data from antenatal clinics was not attempted here; methods suggested by WHO could be investigated for application in future analyses [17].

HIV prevalence data were not available for every area and time for which there were nutritional data. To match HIV prevalence data in these cases, a set of rules was used to provide the best estimate, as follows: if HIV data existed for a given area before and after, but not at the same time as, the time when nutritional data were available for that area, then the HIV prevalence was linearly interpolated; if before and after points were not available, the prevalence at the point nearest in time was used; if a district did not have any data at all, the nearest available regional or provincial estimate was used. For some analyses, HIV prevalences were categorized as greater or less than the mean for each country.

Socioeconomic status variables

A number of socioeconomic status and related variables were investigated to characterize areas with respect to malnutrition and to control for potential confounding. Those available for almost all areas were limited, and education was selected as the most widely available. The variables “percentage of women with no education” and “percentage of women completing primary education or greater” were extracted from DHS reports; of these the first (no education) was finally used as a proxy for overall socioeconomic status.

Drought

Estimates of food and agricultural production were available, usually reported about 2 years after the end of the crop year, from the Food and Agriculture Organization (FAO) FAOStat [18]. These provide for a quantitative assessment of drought effects. Food production indices (FProdI), which are measures of net annual national agricultural food production, were retrieved for each country for the years 1988 to 2006. These production estimates were standardized with reference to the average for 1999 to 2001, which included drought years; therefore, the indices were recalibrated to nondrought years as 100, as follows: Kenya, 1994, the index was 124.9; Ethiopia, 1996, the index was 106.8; Sudan, 1994, the index was 136.6. When plotted against time, a substantial secular trend in FProdI was seen; the residual (the difference between the observed and predicted values of the dependent variable for each case) was derived from the regression of “year” (independent variable) with “food production index” (dependent variable). This variable was created for each country separately and was then combined into a variable taking a specific value for each country-year (at the national level). This variable gives the national annual deviation from the long-term trend and is taken as a measure of drought; its value in practice was from –10 (drought) to +10 (bumper crop) in the Horn countries and from –20 to +20 in Southern Africa.

Food prices

The food price index (FPI) and the consumer price index (CPI) values (set at 100 for 1990) were extracted from the International Labour Office (ILO) database [19] for Ethiopia, Kenya, and Uganda in the Horn (not available for Eritrea) and for Malawi, Mozambique, Zambia, and Zimbabwe in Southern Africa. The data were also available for Malawi, Zambia, and Zimbabwe at the time from national sources (rather than ILO), but although these were used for initial analyses, they have been replaced by the ILO-derived data here for consistency [19]. When the ratio of the indices goes above 1, that is, when FPI increases exceed CPI, the relative cost of food is increasing in relation to the cost of other goods on the market, providing an indication of increasing difficulty in access to food, or food insecurity.

Results

National underweight trends

Trends in prevalences of underweight children estimated at the national level, by year, are shown in **figures 1** and **2**. In most countries up to about 2000, there was a

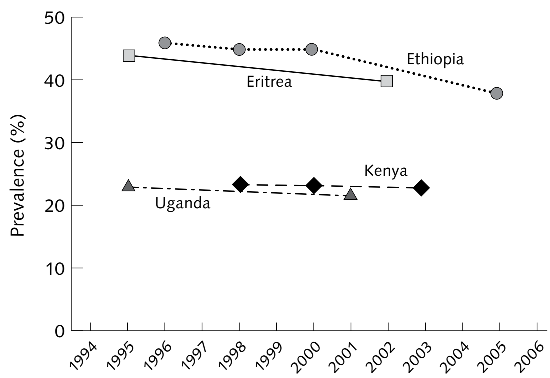

FIG. 1. Trends in national underweight prevalence in Horn countries

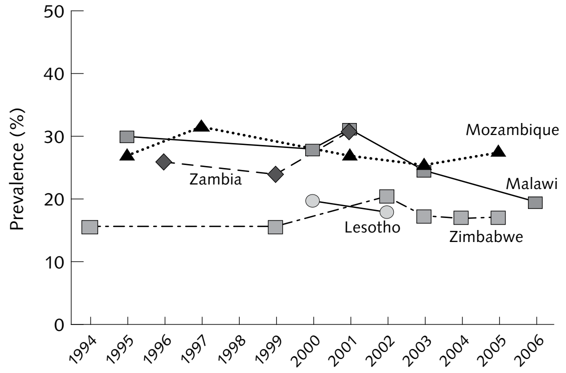

FIG. 2. Trends in national underweight prevalence in Southern African countries

trend toward slow improvement at about 0.5 percentage points per year. In 2000–02, underweight prevalences increased in Southern Africa by about 5 to 10 percentage points with drought and economic recession; after 2002–03, malnutrition prevalences fell again to around pre-2000 levels (**fig. 1**). The exception is Mozambique, where food production fell again in 2005.

In Ethiopia, Kenya, and Uganda, the trends were more consistent than in Southern Africa (**fig. 2**), with an overall trend of improvement in the period from 1995 to 2005, and with the effects of intermittent drought not apparent at national levels in these data. The estimated improvement in Ethiopia from 2000 to 2005, according to local survey results (Welfare Monitoring Survey [WMS]), was also seen in the DHS national estimates (42.0% in 2000, 34.6% in 2005, according to the WHO database); although these surveys were repeated at different seasons (both WMS and DHS), it seems likely that the estimated improvement reflects actual change.

Drought, food production, food prices, and malnutrition

The deviations in food production index from the trend, calculated separately for each country, are shown in **figures 3** and **4**. The food production index was chosen rather than crop production or total agricultural production, as likely to reflect changes in food availability; in any event, all three were found to be highly correlated. The trend through time of the food production index was strongly positive, in part because of population growth. Deriving the residual from the regression of food production index against year gives an estimate of deviations from the long-term trend and thus a convenient indicator of annual variations in national food production.

The periods of reduced food production (mainly due to drought) can be summarized approximately as follows. In the Horn countries (**fig. 3**): Kenya, 1993, 1995–98, 2000, 2004–05; Ethiopia, 1993–95, 1998–2000 (2003–04 had slightly low production but no reports of drought), 2005; Uganda, 1994, 1996–99, 2005. In Southern Africa (**fig. 4**): Lesotho, 1991–92, 1995, 1998–99, 2002–03; Malawi, 1992, 1994–97, 2002–03; Mozambique, 1991–95, 2000–03, 2005; Swaziland, 1995–98, 2000–01; Zambia, 1992, 1995, 1998, 2001–02, Zimbabwe, 1991–93, 1995, 1998, 2002, 2004–05.

Not all year-to-year variations are due to changes in agricultural conditions. The plunge in production in Malawi in 2002 was considered partly due to economic factors. The conflict between Ethiopia and Eritrea in 1998–2000 no doubt contributed to low production at that time.

Food purchasing power may also be tracked using the FPI/CPI ratio, which is available from ILO [19]. The food production indicator (deviations in food production index) in most countries was found to be associated with FPI/CPI, more with the FPI/CPI in the *following* year—e.g., the production indicator in 2000 with FPI/CPI in 2001—than in the current year. Taking the data for the nine countries together, the regression coefficient for FPI/CPI (next year) with production indicator (as independent variable) was −0.27 (p = .018, n = 101); this can be compared with an nonsignificant association (p = 0.32) using FPI/CPI for the same year. The association was stronger in the Horn countries; for FPI/CPI (next year), the coefficient was −0.54 (p = .014, n = 45); it was also associated, less strongly, with FPI/CPI in the same year (coefficient, −0.42; p = .04; n = 46).

The relative price of food (FPI/CPI) appears to some extent to predict changes in underweight. The association of underweight with FPI/CPI was tested by regression for the national data from the nine countries together. The association of FPI/CPI with underweight in the following year (e.g., FPI/CPI in 2000 with underweight in 2001) was weakly positive (the expected

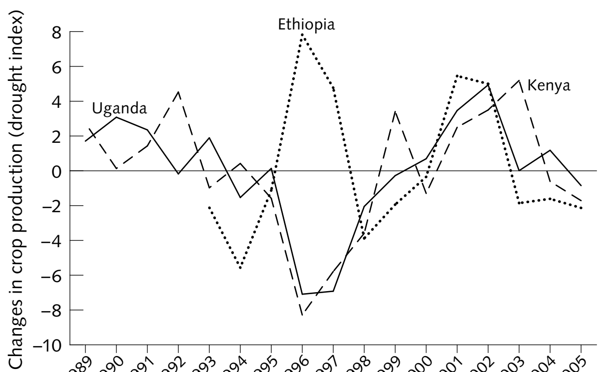

FIG. 3. Trends in food production index (FPI) (standardized) in Horn countries

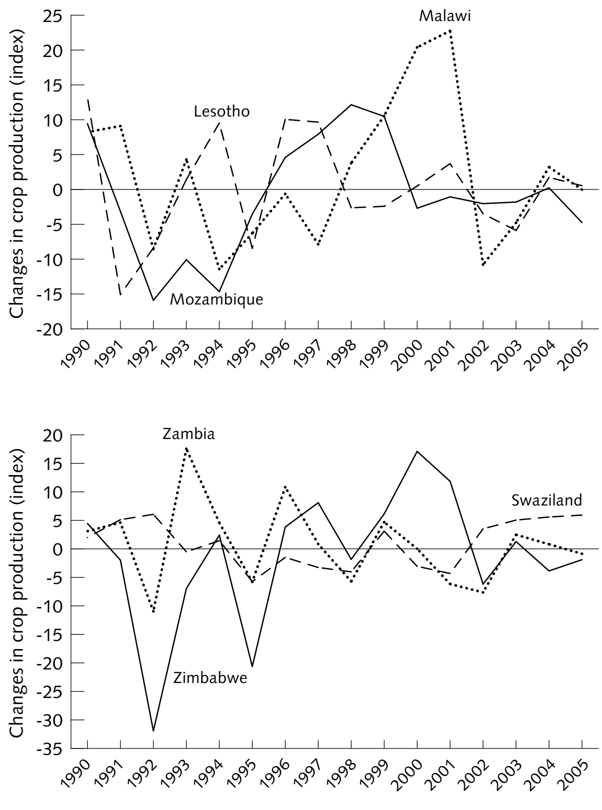

FIG. 4. Trends in food production index (FPI) (standardized) in Southern African countries

direction) where these data were available; the results were underweight (next year) = −5.0 +0.306 FPI/CPI (coefficient $p = .16$, $n = 34$).

Underweight, HIV, and socioeconomic status

HIV/AIDS as well as drought is expected to cause substantial year-to-year changes in child nutrition. Estimates of HIV/AIDS prevalences from antenatal clinic surveillance for Southern Africa are shown in **figure 5**; the pattern has been one of rapid spread during the 1990s, leveling off around 2000. The overall levels in the 2000s are among the highest in the world: 25% to 35% in Lesotho, Swaziland, and Zimbabwe. In the Horn (**fig. 6**), the highest HIV prevalences for Uganda (20% to 25%) were in the early 1990s, since then falling to a reported level of less than 10%. In Ethiopia, the peak was reported in 1995, at 20% to 25%, since then apparently falling to less than 10%; however, HIV data only cover limited areas, and these estimates depend considerably on urban results, especially those from Addis Ababa. Kenya reported a slower increase in the 1990s, reaching about 20% in 2000, since then also falling to less than 10%.

In Southern Africa, the association of HIV prevalence with the prevalence of underweight at the area level was previously shown to be significantly in the direction of a *higher* prevalence of HIV associated with a *lower* prevalence of child underweight. The likely reason is that HIV prevalence is higher in areas of higher socioeconomic status, and higher socioeconomic status is associated with a lower prevalence of child underweight. For both Southern Africa and the Horn countries, indicators of socioeconomic status were created from data in the DHS and MICS surveys; data on women's education, which are widely available, were selected to match the nutritional and HIV data. The level of women's education was strongly correlated with HIV prevalence in both country groups. Higher HIV prevalence was associated with a lower percentage of women with no education ($p = .00$). The percentage of women with no education was strongly correlated with underweight prevalence ($p = .00$) in both country groups, no education being associated with more malnutrition. Higher HIV prevalence was correlated with lower underweight prevalence ($p = .00$) in both country groups.

The regression results are shown in **table 2**. The coefficients for HIV prevalence with child underweight prevalences are significantly negative in Southern Africa (model 1) and the Horn countries (model 4). These coefficients become less negative and less significant when controlling for education (models 2 and 5), confirming that the association of underweight with HIV is mainly due to confounding by socioeconomic status, although it should be noted that some degree of negative association remains for Southern Africa, and indeed this persisted when other available socioeconomic status variables were included (results not shown here). Finally, models 3 and 6 show that the relation between HIV and underweight is not much affected by the drought variable (see below).

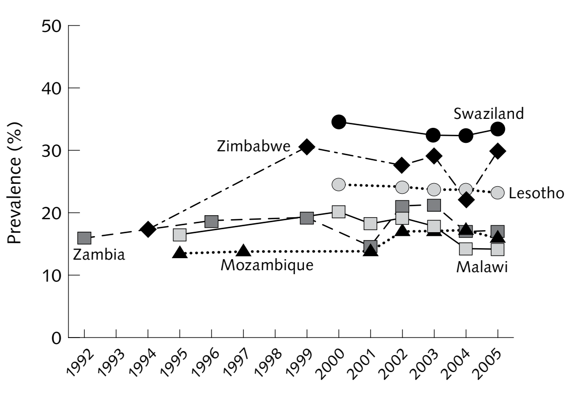

FIG. 5. Trends in HIV prevalence in Southern African countries

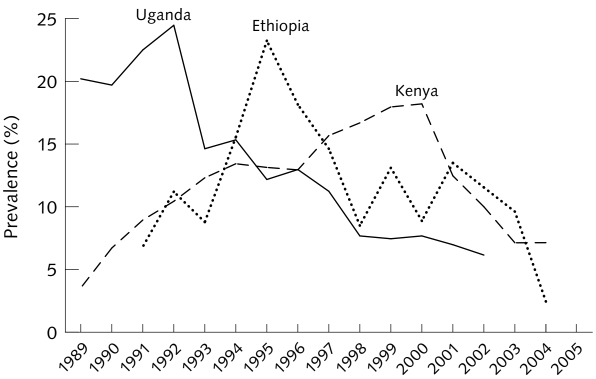

FIG. 6. Trends in HIV prevalence in Horn countries

The influence of drought and HIV together on underweight

Drought (leading to increased food insecurity), assessed by the food production index deviations variable, applies at the national level, since the production estimates are made nationally (at the end of the crop year). HIV can be assessed by area (e.g., province), here derived from surveillance clinics in the area rather than from population-based surveys. Underweight prevalences are estimated at the area level from representative surveys, although these are not available every year. Assembling these data allows examination of associations of underweight with HIV and drought at the area level. Drought and HIV are not themselves related (correlations are nonsignificant, $p > .3$), but they may interact with each other, as shown before in Southern Africa (**fig. 5** in [3]), where the combination of high HIV prevalence and drought was found to be associated with the highest underweight prevalences. This finding was further studied with additional data for Southern Africa, and studied for the first time in the Horn countries. Relations between drought, HIV, and underweight are summarized in **table 3**.

The interaction of drought and HIV continues to be seen in the Southern Africa results—the prevalence of underweight is significantly higher in times of drought in the high-HIV group (19.6% rises to 26.2%, $p < .05$), but not in the low-HIV group—consistent with earlier findings (by regression the interaction is significant at $p = .05$). In the Horn countries, the prevalence increases with drought in both high- and low-HIV areas (no significant interaction), more so in the low-HIV group (22.2% rises to 35.0%, an increase of 12.8 percentage points; $p < .05$).

In the Southern African countries, underweight prevalences are on average 3.4 percentage points higher in drought than nondrought years (24.7% vs. 21.3%, respectively; $p < .05$). In the Horn countries, the effect of drought is greater: 28.0% in drought years vs. 20.4% in nondrought years, an increase of 7.6 percentage points ($p < .05$).

Discussion

National trends in child underweight prevalences showed long-term improvement in the Horn countries assessed, with Ethiopia showing a decrease in prevalence at about 0.9 percentage points per year from 1996 to 2005. Kenya and Uganda showed slower progress, at around 0.1 to 0.3 percentage points per year, but with prevalences about half those of Ethiopia. The countries of Southern Africa, except for Mozambique, showed indications of recovery in underweight prevalences after the severe conditions of the early 2000s. The longer-term trend (from the 1990s to the 2000s) is

TABLE 2. Regression analysis: Decrease in coefficient for HIV on underweight prevalence, after controlling for socioeconomic variables[a]

	Southern African countries			Horn countries		
Variable/model	1	2	3	4	5	6
HIV prevalence (%) (hivfin)	−0.330 −3.80 0.000	−0.158 −1.93 0.056	−0.146 −1.76 0.080	−0.765 −3.51 0.001	0.059 0.43 0.673	0.063 0.41 0.684
Women with no education (%) (noedf)	—	0.258 5.92 0.000	0.255 5.84 0.000	—	0.438 10.36 0.000	0.440 8.51 0.000
Drought (food production index standardized) (resfin)	—	—	−0.102 −1.12 0.267	—	—	0.016 0.06 0.954
Constant	30.36	18.72	18.76	32.51	8.40	19.217
N	136	136	136	43	43	43
Adjusted R^2	0.120	0.298	0.299	0.212	0.781	0.607

a. Dependent variable: underweight (uwfin). In cells: coefficient (*B*), *t*, *p*.

TABLE 3. Mean underweight prevalences by HIV prevalences (above or below average for country) and drought (annual food production index above or below average for country), for countries in Southern Africa and Greater Horn, 1998–2005[a]

	Southern African countries			Horn countries		
HIV prevalence	No drought	Drought	Total	No drought	Drought	Total
Low						
Mean	23.1%	23.6%	23.4%	22.1%	35.0%[b]	30.1%
95% CI	19.8–26.4%	20.1–27.1%	21.0–25.8%	19.2–25.1%	28.9–41.0%	25.3–34.8%
n	36	37	73	8	13	21
High						
Mean	19.6%[c]	26.2%[b]	22.4%	18.4%	22.0%[d]	20.9%
95% CI	17.3–21.9%	23.4–29.0%	20.5–24.3%	13.9–23.0%	16.6–27.3%	16.9–24.8%
n	39	28	67	7	15	22
Total						
Mean	21.3%	24.7%[b]	22.9%	20.4%	28.0%[b]	25.4%
95% CI	19.3–23.3%	22.4–27.0%	21.4–24.4%	17.7–23.1%	23.4–32.7%	22.0–28.7%
n	75	65	140	15	28	43

a. Data are from available surveys (see **table 1**). Southern Africa countries are Malawi, Mozambique, Zambia, and Zimbabwe; Greater Horn countries are Ethiopia, Kenya, and Uganda. Interactions of HIV and drought, by regression, with underweight as dependent variable: Southern, $p = .05$; Horn not significant. For Southern Africa, low and high HIV prevalence are defined as less than or greater than the mean for each country, respectively; for Horn countries, low and high HIV prevalence are defined as less than, or equal to or greater than, the median for region, respectively. "Drought" and "no drought" are defined by deviations from the long-term trend in food production index in each country (see text); "no drought" as deviations positive (or zero), i.e., as good as or better than trend, "drought" as negative, i.e., below trend.

b. $p < .05$ for the comparison between drought and no drought.

c. $p = .08$ for the comparison between low and high HIV prevalence.

d. $p < .01$ for the comparison between low and high HIV prevalence. All other comparisons within country groups are not significant.

probably similar to that in Kenya and Uganda, about 0.1 to 0.3 percentage points per year. The exception is Malawi (where the problem in 2000–01 involved economic and food security management), which had a rate of about 0.9 percentage points per year, indicating rapid recovery.

The impact of drought could be assessed, retrospectively, from FAO's food production index, deriving the deviation from the trend, by country and year. This indicator was broadly associated with child malnutrition, so that underweight prevalences were shown to be higher when food production was below average ("drought" vs. "no drought"), with a greater effect in the Horn countries (**table 3**). The link from food production to the relative price of food (FPI/CPI) appeared to operate with a lag, so that lower food production was associated with higher food prices the following year. Raised food prices themselves were weakly associated with an increased prevalence of underweight. In preliminary studies (not shown), it was seen that early warnings of food shortages were generally borne out by subsequent falls in food production; thus, the sequence of early warnings, production shortfalls, raised food prices, and increased malnutrition could be traced, although the associations are weak with the available data.

Higher HIV prevalences by area are associated with *lower* underweight prevalences. This initially counterintuitive result from area-level analysis was seen in the Southern African countries previously [3]. The correlation is similar in the Horn countries and is confirmed with additional newer data points in Southern Africa. The likely explanation for this ecologic correlation is that areas of higher socioeconomic status had higher prevalences of HIV and (as yet) lower prevalences of child malnutrition, i.e., underweight. Recently, household-level data from Kenya (DHS), including HIV status, have confirmed higher percentages of HIV-positive adults in households with higher socioeconomic status [4, 5], supporting part of the hypothesis.

The negative bivariate association of child underweight with HIV prevalence (at the area level) was weakened substantially in Southern Africa and eliminated in the Horn countries after controlling for socioeconomic status (using women's education as a proxy). This supports the supposition that the associations are as described (high socioeconomic status with high HIV prevalence, high socioeconomic status with low malnutrition prevalence) and that the bivariate association between HIV and underweight is due to confounding (**table 3**). The relation is still important for targeting—it remains that high-HIV areas should be targeted for intervention to protect child nutrition—but in no way suggests that higher HIV prevalence is causally associated with better child nutrition.

The effect of drought in Southern Africa was previously estimated to be greater in areas with a higher prevalence of HIV [3]. Although areas with higher prevalence of HIV had lower malnutrition prevalences prior to drought, malnutrition prevalences in high HIV areas increased more during drought. This effect continued to be observed for Southern African countries, with additional data now included (**table 3**). However, in the Horn countries, the effect of drought was significant only in low-HIV areas, and the overall effect was greater—around 8 percentage points overall increase with drought, as compared with 3 percentage points overall in Southern Africa, or 7 percentage points in the high-HIV areas there. In Southern Africa, it was observed that the areas nearer to major towns, including periurban areas, were the most affected by HIV and deteriorated most in drought, probably related to greater vulnerability to poverty and food insecurity, perhaps enhanced by migration. In Kenya and Ethiopia (where most of the data come from), the more remote areas were the most drought affected; these had the lowest prevalences of HIV, and moreover the average HIV prevalences in these countries were about half of those in Southern Africa (**figs. 5** and **6**). The effects of drought are thus distributed as expected in these countries, in contrast to Southern Africa.

Overall, drought has been reducing the underlying improving trend in underweight prevalences. Although recovery from drought is associated with prevalences falling back to previous levels, it is likely that the underlying rate would be accelerated if these effects were better controlled (or if drought were less common). In other words, effective emergency programs would be expected to have longer-term effects as well.

Put the other way, despite all the setbacks, the underlying trends in reducing malnutrition may be slowly improving. The benefits of successfully controlling drought and disease will be to unmask the potential for establishing sustainable improvement. Economies in the region have been growing overall [20], and crucial factors such as education, especially for girls, are moving ahead [21]. These provide essential context for sustained progress. With additional programs of national coverage, rates of improvement in child growth could be accelerated, in some cases approaching the Millennium Development Goals target of halving child malnutrition by 2015.

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Fluctuations in wasting in vulnerable child populations in the Greater Horn of Africa

Sophie Chotard, John B. Mason, Nicholas P. Oliphant, Saba Mebrahtu, and Peter Hailey

Abstract

Background. *Malnutrition in preschool children, usually measured as wasting, is widely used to assess possible needs for emergency humanitarian interventions in areas vulnerable to drought, displacement, and related causes of food insecurity. The extent of fluctuations in wasting by season, year-to-year, and differential effects by livelihood group, need to be better established as a basis for interpretation together with ways of presenting large numbers of survey results to facilitate interpretation.*

Objective. *To estimate levels of and fluctuations in wasting prevalences in children from surveys conducted in arid and semiarid areas of the Greater Horn of Africa according to livelihood (pastoral, agricultural, mixed, migrant), season or month, and year from 2000 to 2006.*

Methods. *Results from around 900 area-level nutrition surveys (typical sample size, about 900 children) were compiled and analyzed. These surveys were carried out largely by nongovernmental organizations, coordinated by UNICEF, in vulnerable areas of Eritrea, Ethiopia, Kenya, Somalia, Southern Sudan, and Uganda. Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS) data were used for comparison. Data were taken from measurements of children 0 to 5 years of age (or less than 110 cm in height).*

Results. *Among pastoral child populations, the average prevalence of wasting (< –2 SD weight-for-height) was about 17%, 6-7 percentage points higher than the rates among agricultural populations or populations with mixed livelihoods. Fluctuations in wasting were greater among pastoralists during years of drought, with prevalences rising to 25% or higher; prevalences among agricultural populations seldom exceeded 15%. This difference may be related to very different growth patterns (assessed from DHS and UNICEF/MICS surveys), whereby pastoral children typically grow up thinner but taller than children of agriculturalists. Wasting peaks are seen in the first half of the year, usually during the dry or hunger season. In average years, the seasonal increase is about 5 percentage points. Internally displaced people and urban migrants have somewhat higher prevalence rates of wasting. Year-to-year differences are the largest, loosely correlated with drought at the national level but subject to local variations.*

Conclusions. *Tracking changes in wasting prevalence over time at the area level—e.g., with time-series graphical presentations—facilitates interpretation of survey results obtained at any given time. Roughly, wasting prevalences exceeding 25% in pastoralists and 15% in agriculturalists (taking account of timing) indicate unusual malnutrition levels. Different populations should be judged by population-specific criteria, and invariant prevalence cutoff points avoided; interpretation rules are suggested. Survey estimates of wasting, when seen in the context of historical values and viewed as specific to different livelihood groups, can provide useful timely warning of the need for intervention to mitigate developing nutritional crises.*

Key words: Africa, child nutrition, drought, seasonality, wasting

Background

Populations in low-rainfall areas of the Greater Horn of Africa (Eritrea, Ethiopia, Kenya, Somalia, Sudan, and Uganda) are particularly vulnerable to food insecurity and malnutrition resulting from drought and local conflicts. This vulnerability stems in part from the

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environment itself, with considerable dependence on cattle-raising and a nomadic or seminomadic lifestyle. Livelihood is threatened by increasingly erratic climatic conditions and from competition for resources and political instability.

Judging when to intervene to mitigate malnutrition depends on various sources of information. Of the several warning systems, the most developed is probably the food security information system for Somalia [1], which employs a set of data ranging from rainfall reports and satellite imagery to household surveys, including child nutrition. Ethiopia, as another example, has an early warning system linked to nutritional surveillance (e.g., [2]).

Although nutritional indicators may change late in a developing crisis, they are widely used to provide a direct and objective estimate of current status. Measuring child nutrition in vulnerable areas currently depends largely on cross-sectional area-level surveys, typically with sample sizes of about 900 (30 households by 30 clusters), usually carried out at a few weeks' notice. Because of difficulties in estimating age, these surveys usually rely on wasting in children as the measure of nutritional outcome. This paper is about the interpretation of levels and fluctuations in wasting prevalences in different populations.

Differences in wasting prevalences occur according to livelihood group, season, and year-to-year conditions.

The significance of differentials by livelihood—typically between pastoralists and others—is not widely agreed. Table 20 in the World Health Organization (WHO) publication "The management of nutrition in major emergencies" [3] puts forward a classification for severity of malnutrition based on prevalences of wasting irrespective of population type (e.g., prevalences of 10% to 14% indicate serious malnutrition, 15% or more critical malnutrition). Similar invariant trigger levels for intervention are adopted by many guidelines (e.g., Sphere [4]). However, pastoral children's growth patterns differ considerably from those of children in populations with other livelihoods [5, 6], and their typically higher wasting prevalences, with lower stunting, affect interpretation. For example, in 2000–03, the prevalences of wasting in the Northeast Province of Kenya (mainly a pastoral population) were 14% to 27%, compared with 8% to 10% in Nyanza (mainly agricultural), and the prevalences of stunting in the Northeast Province of Kenya were 27% to 38%, compared with 36% to 41% in Nyanza [7, 8]. The persistently higher prevalence of wasting in pastoralists does not match a simple picture of chronic malnutrition, since the prevalence of stunting is lower.

Variations by season are not well established, since most large surveys are infrequent and are not matched by season. However, previous data from clinic reports from nine African countries [9] indicated seasonal fluctuations of around 5 percentage points in the prevalence of low weight-for-age. Studies in Southern Ethiopia concluded that seasonal weight changes, although significant in adults (about 1.5 kg between seasons) [10], were not significant in children. In Gambia, the prevalence of wasting fluctuated between about 4% and 10% between seasons [11]. In Zimbabwe, the prevalence of underweight varied (in some areas) by 1 to 2 percentage points [12]. The largest reported seasonal fluctuations in wasting were of 10 percentage points (from 7% to 17%) in children in Mali [13]. Knowing the typical seasonal fluctuation should be useful both for assessing the severity of malnutrition at one time and for predicting early how far malnutrition rates are likely to rise with the onset of leaner times.

Year-to-year changes have been assessed at the national and provincial levels from repeated national surveys [14]. However, these do not have the sample sizes necessary to assess changes in relatively small populations at the district or lower levels. Wasting prevalences from national surveys may give context to more rapidly available surveys, but results from national surveys are seldom available in time to help in intervention decisions. Small-scale area-level surveys are usually a more timely and focused source.

What interventions are most relevant? The major concerns are for acute food shortages leading to rapidly deteriorating nutrition (particularly affecting children) and triggering population movements. The most frequent causes are drought, with insecurity from local conflict, floods, and other environmental threats sometimes contributing. The usual interventions involve distribution of food aid, often with emergency public health measures when disease outbreaks occur.

Because of concern for food insecurity and severe malnutrition, a large number of area-level surveys have been conducted in recent years, increasing during widespread drought in 2000 and continuing in the following years. Most of these were conducted by nongovernmental organizations, with UNICEF coordination in many cases; for Somalia, the Food and Agriculture Organization (FAO)–led Food Security Analysis Unit (FSAU), based in Nairobi, was the focal point. As part of research sponsored by UNICEF, a total of 905 survey results from 2000 to early 2006 were compiled from six countries (Eritrea, Ethiopia, Kenya, Somalia, Southern Sudan, and Uganda), with typical sample sizes of around 900 preschool age children; the results derive from measurements on nearly 1 million children. The areas covered are indicated on the map in **figure 1**. Analysis of the results of these surveys forms the basis of this study, aimed at examining population-based criteria for determining the need for emergency interventions.

FIG. 1. Arid and semiarid land areas from which surveys from 2000 to 2006 were compiled for this study. Areas studied here are shaded dark gray. Areas for which data are presented in **figure 5** are indicated: Rift Valley Province in Kenya and Somali and Oromia Regions in Ethiopia.

Methods

All the survey results compiled were obtained from survey reports that were made available through the UNICEF Eastern and Southern Africa Regional Office (ESARO). The surveys were conducted by nongovernmental organizations, sometimes together with the responsible government department; for example, in Ethiopia in 2004, of the 86 surveys compiled, the following agencies took the lead: Save the Children (UK and US) 29%, CARE 17%, government (Disaster Preparedness and Prevention Department) 14%, GOAL 14%, CONCERN 13%, CRS (Catholic Relief Services) 5%, International Medical Corps (IMC) 5%, and World Vision (WV) 3%.Our aim was to compile all the survey results. A total of 905 surveys were found (after eliminating duplicate results reported through multiple channels) with nutritional outcome reported (child wasting); 8 surveys had incomplete data, giving a dataset of 897 survey results.

Survey sampling was almost always two-stage, by cluster then household or child, usually with 30 clusters selected then 30 households or children—generally following the standard procedures based on CDC methods, as described, for example, in SMART [15]. The final stage of household selection varied, the most common method being to select a random direction (spinning a bottle) then systematically selecting households with a sampling interval calculated to yield the requisite number (e.g., 30) between the starting point and the edge of the settlement. Households without children present were usually replaced by visiting neighboring households until a child was identified. If more than one child was present in a visited household, either all were measured or only the youngest was measured. In most cases, children's eligibility was based on height (60 to 110 cm) rather than age (up to 60 months), but as these two measures are largely equivalent, the choice of method has little effect on the results.

Eight sets of original data were available for some additional studies (reported elsewhere [14]), and these also provide some information on data quality. The additional studies were conducted in Sool, Somalia, in June 2003 (n = 901); Gulu, Uganda, in October 2004 (n = 5,451); Kotido, Uganda, in August 2004 (n = 931); Moroto, Uganda, in August 2004 (n = 952); Nakapiripirit, Uganda, in August 2004 (n = 897); Akobo, Southern Sudan, in September 2005 (n = 925); Kajo Keji, Southern Sudan, in June 2005 (n = 915); and Jilibi, Somalia, in May 2004 (n = 913). The descriptive results in the next paragraph are from these eight studies.

Age was recorded in most surveys, but the data showed extensive age-heaping at 12, 24, 36, 48, and 59 months (e.g., in Sool, 37% of child ages were at these precise values). Wasting was therefore the only anthropometric estimate generally available, and was compiled from all 897 survey reports. Edema was also recorded, but the prevalence was low (less than 1%). Unfortunately, many surveys reported only the combined total of wasting (< –2 SD weight-for-height) plus edema, referred to as "global acute malnutrition" (GAM), which in principle is not an exclusive combination (some children could be wasted and edematous). In practice, edema prevalence is low (mean, 0.8% in the eight datasets; range, 0% to 2.2%) and only partly overlaps with wasting. GAM and wasting prevalences are similar [16], and GAM is taken here as equivalent to wasting for these analyses.

The month of the survey was recorded in most cases; when the month was not recorded, enquiries were made as to the season, which was recorded as hunger, moderate, or postharvest. The major livelihood of the population surveyed (pastoral, agropastoral, agricultural, or urban) was assessed from the survey reports; in addition, some surveys were conducted in camps of internally displaced people (IDP). A number of other factors were included, e.g., whether drought, flood, or conflict was considered the main risk, and these too were coded.

The results from 897 surveys were assembled into a dataset (in SPSS), each case being a survey result. This was done in two stages—the first in late 2005 and the second in mid-2006—both with newly identified surveys and with those recently carried out. Duplicates were removed. The prevalence of GAM (referred to here as wasting, the main component) ranged from 1% to 44%, and all these values were included.

The key variables used in the analyses, with their derivations, were as follows.

Area. The primary designations were country and province or region. For certain analyses, Ethiopia was divided into the lowland regions (Afar and Somali), which are mainly pastoral, and those of higher elevation, with more dependence on agriculture (Amhara, Oromia, SNNPR, and Tigray); these are designated as Ethiopia (Afar and Somali) and Ethiopia (other regions), respectively.

Season. Harvest times vary within countries, but here a standard designation by country was used, from a crop calendar constructed from harvest timing [17] and local enquiries. Harvests were taken as follows: Ethiopia, November–December; Kenya, September–October; Somalia, August–September; Sudan, November. The seasons were thus coded as follows: Ethiopia (Afar and Somali regions)—moderate April–June, hunger (or lean) July–October, postharvest November–March; Kenya—moderate February–May, hunger June–September, postharvest October–January; Somalia—moderate January–April, hunger May–August, postharvest September–December; Sudan—moderate February–May, hunger June–August, postharvest September–January. In Uganda, seasonal variations are less pronounced and seasons were not coded (all months were defined as the moderate season). When the survey month was not recorded, season was assigned on the basis of other information in the report or from further enquiries; this applied to 233 cases (month not reported), and a code could be assigned for those with missing month data to all but 20 cases (and these were not significantly different in mean wasting prevalence). This designation was used to derive dummy variables for moderate and hunger seasons, with postharvest as the excluded group in regressions. These designations derive from crop calendars, and for pastoral populations the times of food shortage may be somewhat earlier, as livestock production may start to recover sooner than the crop harvest after the rains start; the dry season may thus be an important definition for these populations, corresponding to parts of the moderate and hunger seasons.

The postharvest season bridged calendar years (e.g., October through January in Kenya), so that seasons were recoded by country sequentially, from 0 to 21 for the 7 years; e.g., for Kenya, 0 was postharvest in January 2000, 1 was moderate in February–May 2000, 2 was hunger in June–September 2001, 3 was postharvest in October 2000–January 2001, and so on, finishing with postharvest 2006 as 21. This coding was applied where seasons were most important, i.e., Kenya, Somalia, Sudan, and Ethiopia (Afar and Somali). Months were also coded cumulatively from Jan 2000 (as 1) to December 2006 (as 84), for coding seasons as above and for analysis by month.

Livelihoods. The main livelihood for the population group surveyed was recorded as, first, pastoral, agricultural, agropastoral (i.e., mixed), or urban. Surveys of IDP camps were included (n = 120), and these were coded as a further livelihood category. Finally, livelihoods were not generally reported for Southern Sudan surveys (n = 143), so except for the 10 in IDP camps, the rest (n = 133) were coded as a separate livelihood category. This process simplified analysis and allowed

Sudan to be satisfactorily included in the regression analyses. Dummy variables were derived for each category, as shown in the tables in this article, with agricultural the excluded category, except for Kenya, for which the agropastoral category was used. There were no missing values.

Risk factors. A number of surveys were done because of specific concerns—drought, floods, insecurity, and returning IDP. Where reported these were recorded, but in all cases except drought, more than 80% of the values were missing. Differences in nonmissing values between factor present or absent were of the order of 2 percentage points. This correlation with missing values was not directly pursued further. Drought was not reported consistently, by year or area: 151 cases were positive (out of 260 nonmissing). Drought was used as a dummy variable (1 = drought reported, 0 = drought specifically not reported or missing). The dummy variable for drought was included in regressions but was not generally significant; it was included also in the adjusted means for constancy with the regressions, although the effect was small.

Drought was assessed quantitatively at the national level, and an annual measure was derived for the difference in crop production index from the trend, by country, as reported in [18].* However, the national estimates (from production data) are only weakly related either to local drought stress, as reported here, or to other measures, presumably because this analysis applies to arid and semiarid lands, which are overall relatively minor contributors to national production and are subject to local drought risks that may not affect other areas as badly. Moreover, the production-based estimates are annual. Conditions in vulnerable subnational areas by season can be looked up (including retrospectively) in the FAO Foodcrops and Shortages reports [19].

Analysis was done primarily in SPSS, with graphics done in Excel. Regressions were Ordinary Least Squares (OLS). Where adjusted prevalences are reported (tables in the Results section), these were adjusted for the same covariates as in the regression models, using the GLM/Univariate routine in SPSS (adjusting by covariates as given in the footnotes to the tables).

Some additional analyses were done comparing pastoral and agricultural groups, controlling for socioeconomic status, in terms of wasting and stunting in defined representative samples. These used the DHS datasets for Kenya for 2003 and Ethiopia for 2005, downloaded from the Measure/DHS website [20]. Prevalences of wasting and stunting were derived as less than −2.0 SD from the weight-for-height and height-for-age variables in the datasets. Socioeconomic status was proxied by roofing material for Kenya (as grass or tin, which accounted for 88% of the sample) and by a wealth index (in quintiles) provided in the dataset derived from assets. Livelihood was taken to relate to ethnicity for pastoral groups in selected regions. In Ethiopia, the Oromia and Somali regions were selected (having the largest samples of small-scale surveys and thus being the most useful for comparison), and within these the ethnic groups Oromo and Somali, which were generally agricultural (or agropastoral) and pastoral, respectively. In Kenya, the Rift Valley was selected (mixed livelihood), having the most small-scale surveys, and North Eastern Province, mostly pastoral, for comparison. The Somali and Turkana groups were selected as mainly pastoral, compared with others that were agricultural (Maasai were intermediate and were omitted for simplicity).

Results

The data were derived from nearly 900 area-level surveys conducted between 2000 and 2006. Each data point is thus the result of one survey, with the prevalence of children of low weight-for-height ("wasting") as the dependent variable. The surveys do not provide a representative sample, in time or by location (beyond the limited area sampled) or population group, and the prevalence will be affected by season, year, and livelihood, as well as other unmeasured factors, which are not randomized between surveys. The first aim here is to describe the "typical" fluctuations by time and place; thus, the prevalences need to be adjusted for the fortuitous factors also included when the surveys were done. For example, some surveys were conducted among pastoralists in the hunger season and others among agriculturalists postharvest, but as far as feasible we need to compare these. Therefore, the multiple associations have to be first examined, then generalizations are made with adjustment for the heterogeneity of the survey circumstances.

The distribution of the surveys is shown according to seasonal timing in **table 1A** and according to livelihood in **table 1B**. More surveys were done in the moderate (i.e., moderately hungry or lean) season than in other seasons, presumably reflecting the time at which concern was mounting, but the timing does cover all seasons (note that in Uganda, seasonality is minor and seasons are not distinguished, all being coded as moderate). Livelihoods are more skewed. In Kenya and Somalia, most surveys (77% and 48%, respectively) covered pastoral populations, whereas (for example) in Ethiopia, most were agriculturalists. Surveys of IDP (mostly in camps) predominated in Uganda, with a number also in Somalia and Eritrea. The population

* For guidance, the results indicated that production was as follows for the countries with data: Ethiopia, low in 2000, higher in 2001–02, low in 2003–05; Kenya, low in 2000, good harvests in 2001-3, low in 2004-5; Uganda, good harvests in 2001-2, slightly down in 2003 and 2005. No data for Somalia or Southern Sudan.

TABLE 1. Distribution of surveys

A. By country and season.

Season	Variable	Kenya	Somalia	Sudan	Uganda	Eritrea	Ethiopia (other regions)	Ethiopia (Afar and Somali)	Total
Moderate season	*N*	69	50	59	99	1	104	12	394
	%	43.4	56.2	41.3	100.0	9.1	33.5	16.7	44.6
Hunger season	*N*	46	17	41		10	101	27	242
	%	28.9	19.1	28.7		90.9	32.6	37.5	27.4
Posthunger season	*N*	44	22	43			105	33	247
	%	27.7	24.7	30.1			33.9	45.8	28.0
Total	*N*	159	89	143	99	11	310	72	883
	%	100	100	100	100	100	100	100	100
Mean wasting prevalence—% (number of surveys[d])	Unadjusted	20.5 (159)	15.9 (105)	20.9 (142)	9.3 (93)	15.8 (11)	9.6 (310)	19.1 (75)	14.9 (895)
	Adjusted[a]	19.2[b]	15.3[b,c]	22.7[b,c]	8.4[c]	14.4[c]	9.9[c]	18.5[b]	

a. Adjusted for year, season, and drought.
b. Significant ($p < .05$) difference from Uganda.
c. Significant ($p < .05$) difference from Kenya.
d. Where number of surveys differs from 'Total' in earlier row, additional surveys unclassified by season were included, and/or some with missing or outlying values were omitted.

B. By country and livelihood

Livelihood	Variable	Kenya	Somalia	Sudan	Uganda	Eritrea	Ethiopia (other regions)	Ethiopia (Afar and Somali)	Total
Pastoral	*N*	123	50		10		39	26	248
	%	77.4	47.6		10.2		12.6	34.2	27.5
Agropastoral	*N*	15	16		14		88	24	156
	%	9.4	15.2		14.3		28.4	31.6	17.3
Agricultural	*N*		8		14		177	11	211
	%		7.6		14.3		57.1	14.5	23.4
Urban	*N*	19	6		3		1	5	34
	%	11.9	5.7		3.1		0.3	6.6	3.8
Sudan	*N*			133					133
	%			93.0					14.7
IDP	*N*	2	25	10	57	11	5	10	120
	%	1.3	23.8	7.0	58.2	100.0	1.6	13.2	13.3
Total	*N*	159	105	143	98	11	310	76	902
	%	100	100	100	100	100	100	100	100

IDP, internally displaced people

livelihoods were not available for Southern Sudanese (non-IDP) groups, so these were coded as a separate "livelihood" itself, with the 10 IDP camp results coded as such. The urban populations surveyed (mostly in Northeastern Kenya) were mainly people who had migrated from rural areas in response to drought or conflict and (as will be seen) had high levels of wasting; although their previous livelihood was presumed to be pastoral or agropastoral, they are defined here by their urban location.

Overall mean child wasting prevalences by country (pooling livelihoods, seasons, and years) are also shown in **table 1A** (last two rows). The populations in Northeastern Kenya, the Afar and Somali regions of Ethiopia, and Southern Sudan (i.e., the predominantly pastoral and agropastoral groups) have prevalences of around 20%; Uganda and the other (more agricultural) regions of Ethiopia have prevalences of around 10%; the prevalences in Eritrea and Somalia are around 15%. Mean prevalences adjusted for covariates (year, season, and reported drought) are also given (significance levels are in the footnote).

Regression models controlling for livelihood, season, and year, with dummy variables added for country (**table 2A**), confirm that after controlling for livelihood, the wasting prevalences are significantly different between countries. In this model, the livelihood variables become nonsignificant when the country dummies

TABLE 2A. Associations of livelihood, drought, season, year, and country with wasting prevalence

Variable		B^a	Variable		B^a
Livelihood: pastoral	DPAST2	1.18	Kenya	D_KENYA ***	10.30 ***
Livelihood: agropastoral	DAGPAST2	−1.37 *	Somalia	D_SOMALI ***	5.94 ***
Livelihood: urban	DURBAN2	1.99	Sudan	D_SUDAN ***	12.34 ***
IDP	DIDP22	1.49	Ethiopia (Afar and Somali)	D_ETHAS ***	9.15 ***
Drought reported	D_DR2	1.36	Ethiopia (other regions)	D_ETHOTH	1.01
Hunger season	D_HUNG2 ***	1.94 ***	Eritrea	D_ERITRE	2.90
Moderate season	D_MOD2 **	1.46 **	*N*	877	
2000	D_Y00 ***	4.66 ***	Adjusted R^2	0.425	
2001	D_Y01	−0.10			
2002	D_Y02 *	1.75 *			
2003	D_Y03 ***	2.59 ***			
2005	D_Y05	0.21			
2006	D_Y06 *	2.14 *			

IDP, internally displaced people
a. *B* is regression coefficient (ordinary least squares). Constant = 6.02.
* $p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 2B. Associations of livelihood, drought, season, and year: regression coefficients with wasting prevalence as dependent variable[a]

Variable		All	Kenya	Somalia	Sudan	Ethiopia (Afar and Somali)	Ethiopia (all)	Uganda
Livelihood: pastoral	DPAST2	6.701***	7.609***	3.118	NA	1.154	2.433**	10.156***
Livelihood: agropastoral	DAGPAST2	0.535	—	0.396	NA	−0.726	0.863	0.015
Livelihood: urban	DURBAN2	8.634***	9.541***	−0.893	NA	6.515	11.316***	−0.195
IDP	DIDP22	3.375***	13.527*	4.164*	1.944	4.338	7.990***	2.542
Drought reported	D_DR2	1.483	−1.934	3.086*	2.287	2.159	0.064	−0.995
Hunger season	D_HUNG2	1.292*	2.944	−4.382*	4.772**	3.796	1.133	NA
Moderate season	D_MOD2	0.492	3.517*	−4.831*	2.244	3.852	0.620	NA
2000	D_Y00	7.689***	6.100*	−2.524	−7.056	9.076**	7.599***	−3.529
2001	D_Y01	2.038*	−3.683	−0.104	1.063	5.941	3.500**	0.377
2002	D_Y02	2.463**	−1.704	−7.413***	6.314***	9.196**	1.287	NA
2003	D_Y03	2.528**	4.782	−4.430*	2.350	5.107	1.838	8.136***
2005	D_Y05	0.510	−0.868	−7.838**	1.236	3.392	2.102	−1.001
2006	D_Y06	3.616***	3.557	−0.327	4.356	6.569	0.562	−2.469
Livelihood: Southern Sudan	DLSUDAN	10.870***	−1.934	NA	NA	NA	NA	NA
	Constant	7.401***	9.717***	18.765***	16.047	9.322**	7.697***	5.373*
	N	875	159	89	141	71	382	93
	Adjusted R^2	0.296	0.287	0.289	0.174	0.206	0.149	0.496

NA, not applicable
a. The following categories were excluded: for livelihood, agricultural (except for Kenya, where agropastoral was the excluded group, since there were no agriculturalists in the sample); for season, postharvest; for year, 2004 (best year); livelihoods were not known for Sudan, so all Sudan was coded as separate livelihood (DLSUDAN); no seasons were recorded for Uganda, so all Uganda was coded as moderate (for model "'All"). Dependent variable wasting % (AVEGAM2). "All" (first data column) includes Eritrea ($n = 11$). *N*s: a datapoint is a survey result, typically prevalence in around 900 children.
* $p < .05$. ** $p < .01$. *** $p < .001$.

are included, as livelihood tends to be collinear with country (for the areas surveyed), as can be seen from **table 1B**—e.g., pastoralists in Kenya, agriculturalists in Ethiopia. Therefore, when country locations of population groups are taken into account, these predominate over livelihood. However, if the areas covered are taken

TABLE 2B. Associations of livelihood, drought, season, and year: regression coefficients with wasting prevalence as dependent variable[a] (*continued*)

Variable		All	Kenya	Somalia	Sudan	Ethiopia (Afar and Somali)	Ethiopia (all)	Uganda
Livelihood: pastoral	DPAST2	6.701***	7.609***	3.118	NA	1.154	2.433**	10.156***
Livelihood: agropastoral	DAGPAST2	0.535	—	0.396	NA	–0.726	0.863	0.015
Livelihood: urban	DURBAN2	8.634***	9.541***	–0.893	NA	6.515	11.316***	–0.195
IDP	DIDP22	3.375***	13.527*	4.164*	1.944	4.338	7.990***	2.542
Drought reported	D_DR2	1.483	–1.934	3.086*	2.287	2.159	0.064	–0.995
Hunger season	D_HUNG2	1.292*	2.944	–4.382*	4.772**	3.796	1.133	NA
Moderate season	D_MOD2	0.492	3.517*	–4.831*	2.244	3.852	0.620	NA
2000	D_Y00	7.689***	6.100*	–2.524	–7.056	9.076**	7.599***	–3.529
2001	D_Y01	2.038*	–3.683	–0.104	1.063	5.941	3.500**	0.377
2002	D_Y02	2.463**	–1.704	–7.413***	6.314***	9.196**	1.287	NA
2003	D_Y03	2.528**	4.782	–4.430*	2.350	5.107	1.838	8.136***
2005	D_Y05	0.510	–0.868	–7.838**	1.236	3.392	2.102	–1.001
2006	D_Y06	3.616***	3.557	–0.327	4.356	6.569	0.562	–2.469
Livelihood: Southern Sudan	DLSUDAN	10.870***	–1.934	NA	NA	NA	NA	NA
	Constant	7.401***	9.717***	18.765***	16.047	9.322**	7.697***	5.373*
	N	875	159	89	141	71	382	93
	Adjusted R^2	0.296	0.287	0.289	0.174	0.206	0.149	0.496

NA, not applicable

a. The following categories were excluded: for livelihood, agricultural (except for Kenya, where agropastoral was the excluded group, since there were no agriculturalists in the sample); for season, postharvest; for year, 2004 (best year); livelihoods were not known for Sudan, so all Sudan was coded as separate livelihood (DLSUDAN); no seasons were recorded for Uganda, so all Uganda was coded as moderate (for model "'All"). Dependent variable wasting % (AVEGAM2). "All" (first data column) includes Eritrea (n = 11).*N*s: a datapoint is a survey result, typically prevalence in around 900 children.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

TABLE 3. Adjusted mean wasting prevalence (%) by livelihood and country (numbers of survey results in parentheses).

Livelihood	Kenya	Somalia	Sudan	Ethiopia (Afar and Somali)	Ethiopia (other regions)	Uganda	All (adjusted 1)[a]	All (adjusted 2)[b]
Pastoral	21.0 (123)	16.7 (46)	—	18.8 (26)	8.4 (39)	16.8 (10)	15.9 (244)	17.2 (244)
Agropastoral	13.3 (15)	14.0 (16)	—	16.9 (24)	9.3 (88)	6.7 (14)	13.4 (157)	11.1 (157)
Agricultural	—	13.6 (8)	—	17.6 (10)	9.9 (177)	6.7 (10)	14.8 (205)	10.4 (205)
Urban	22.9 (19)	12.7 (2)	—	24.2 (5)	7.0 (1)	6.5 (3)	16.7 (30)	19.1 (30)
Sudan[c]	—	—	20.7 (132)	—	—	—	13.4 (132)	21.4 (132)
IDP	27.4 (2)	17.8 (17)	22.7 (10)	21.3 (6)	10.9 (5)	9.2 (56)	13.5 (96)	14.0 (96)
All (unadjusted)	20.5 (159)	16.1 (89)	20.9 (142)	18.6 (71)	9.6 (310)	9.3 (93)	14.8 (864)	14.8 (864)

IDP, internally displaced people

a. Adjusted for country, season, and year.

b. Adjusted for season and year.

c. No livelihood data was available for results from Sudan; thus Sudan was treated as a separate livelihood group—e.g. the dummy variables representing livelihood (mutually exclusive) were pastoral, agro-pastoral, agriculture, urban, or Sudan—see Methods.

as a whole (i.e., countries pooled and not adjusted or controlled for), the effects of livelihood can be seen. Both approaches, taking countries into account and not, are described below.

Associations of wasting prevalences with livelihood, season, and year are shown in **table 2B** from multiple regression (OLS) models. The equivalent adjusted mean prevalences are presented in **table 3**, as estimated prevalences are easier to interpret than regression coefficients. The results quoted below all refer to effect sizes after controlling for other factors, from these models.

The first results column ("All") in **table 2B** combines the data from populations in the six countries. Wasting prevalence was 6.7 percentage points higher among pastoral groups than among agriculturalists. This is reflected in the prevalence estimates in **table 3**, last column, where the mean prevalence (adjusted for season and year, but not country) for pastoralists is 17.2%, compared with 10.4 % for the agricultural group (the excluded group in the regressions in **table 2B**; $p < .001$). Urban groups also had a significantly higher prevalence of wasting (8.6 percentage points more than agriculturalists), with an adjusted mean of 19.1%, presumably reflecting migration and poverty more than livelihood pattern itself. Children in IDP camps had a wasting prevalence of 14%, which was significantly raised. In the surveys from Southern Sudan, livelihoods were not defined, but overall the prevalence of wasting was estimated to be 21%, similar to values in Kenya and Ethiopia (Afar and Somali).

Within countries (**table 2B**), the pastoral group usually had a higher prevalence of wasting than agriculturalists; the difference is significant in Ethiopia (all) and Uganda, and in Kenya (as compared with agropastoralists). The average wasting prevalence among pastoralists in the lowland areas (i.e., excluding Ethiopia [Amhara, Oromia, SNNPR, and Tigray], is 17% to 21%, compared with 7% to 10% among agriculturalists in nonpastoral areas. Agropastoralists—i.e., populations dependent on both livestock and crops—are intermediate and have lower prevalences in less pastoral areas (Ethiopia [Amhara, Oromia, SNNPR, and Tigray]) and Uganda.

In these surveys, IDP were found mainly in Uganda, as well as Somalia and Sudan. The prevalence rates of wasting among IDP were higher by around 3 percentage points (see regression coefficient for IDPs in **table 2B**; in most countries the coefficient is significant) than those among non-IDP in the same country. The urban populations surveyed—mostly in Kenya—were mostly migrants and thus had some similarities to IDP; these also had wasting prevalences significantly higher than those of other livelihood groups in Kenya and Ethiopia, by about 10 percentage points.

Differences between children of pastoralists and children of agriculturalists are seen not only in the surveys analyzed here, but when different livelihood groups can be compared from broader surveys. Comparing stunting and wasting by age group, in data from Somalia [21] and Uganda [22] shows the striking pattern in **figure 2A**. Ugandan children start with prevalence rates of stunting or wasting of less than 10% at under 6 months of age, with stunting then increasing rapidly to more than 40% after 12 months, with no increase in wasting. Somali children start with prevalence rates of stunting and wasting around 20% at under 6 months of age, and both stunting and wasting continue at around this level. Clearly the growth patterns of these groups—broadly pastoral and agricultural—are very different. Growth measured by weight is more similar between groups, as thinness and stunting balance each other (**fig. 2B**); thus, underweight may be more comparable between different livelihood groups.

Wasting levels among pastoralists and agriculturalists from recent DHS surveys in Ethiopia (2005) [23] and Kenya (2003) [8], which provide results drawn from samples representative of the populations, are shown in **figure 3**. Agricultural or agropastoral populations, such

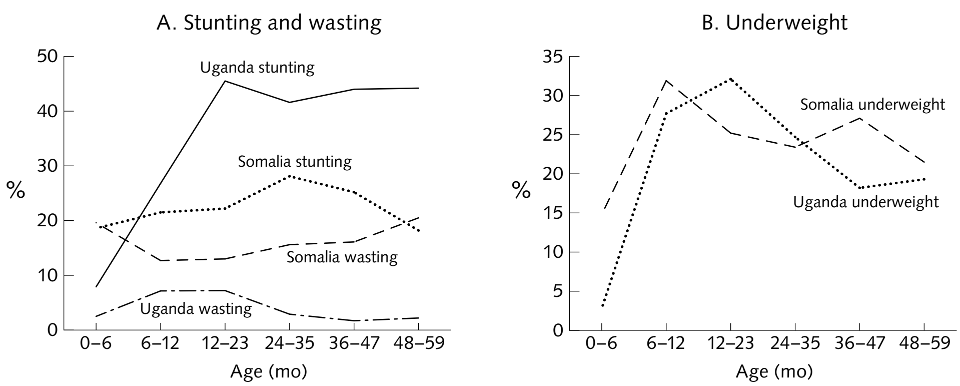

FIG. 2. Growth patterns of children 0 to 59 months of age in Somalia (mainly pastoral livelihoods) and Uganda (mainly agricultural livelihoods). Sources: for Somalia, UNICEF/MICS 1999 [21]; for Uganda, Measure DHS 2000 [22].

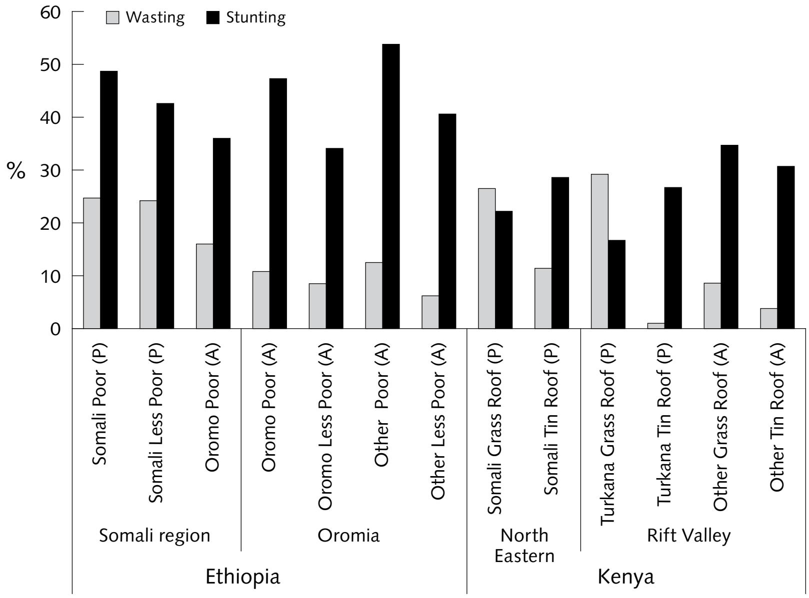

FIG. 3. Prevalence of wasting and stunting by livelihood group—pastoral (P) and agricultural (A) groups—and socioeconomic status in Somali and Oromia Regions (Ethiopia) and North Eastern and Rift Valley Provinces (Kenya)

This chart shows the prevalences of wasting and stunting as the vertical bars. Data are from four areas: Ethiopia, Somali Region; Ethiopia, Oromia Region; Kenya, North Eastern province; Kenya, Rift Valley Province. Within these different ethnic groups (which correspond to livelihood), with poverty status, are shown: Somali (mainly pastoralist) and Oromo (mainly agriculturalist) in Ethiopia, distinguished by poverty status from the reported survey results; and Somali and Turkana (both mainly agricultural) in Kenya, distinguished by housing, tin roof representing improved housing, often associated with a more settled lifestyle.

Sources: DHS surveys: Kenya, 2003 [8]; Ethiopia, 2005 [23].

as the Oromo people in Oromia and the non-Turkana groups in the Rift Valley, have prevalence rates of child wasting around 10%. Wasting prevalence does decrease with decreasing poverty, e.g., from 10.8% to 8.5% in Oromo in Oromia, or from 8.6% to 3.8% in other agricultural population groups in the Rift Valley, using roofing as a proxy (tin roofs indicating less poverty than grass roofs). The Somali population in the Somali Region in Ethiopia had a wasting prevalence of 24%, which did not change with wealth; among the Somalis in Northeastern Kenya, the prevalence of wasting was 27% for those with grass roofs, decreasing to 11% for those with tin roofs. The prevalence of stunting was similar in pastoralists and agropastoralists, decreasing as expected with less poverty among the agropastoralists, but actually increasing slightly in the more settled communities with tin roofs (e.g., in Kenya for Somalis and Turkana). Data are from 2003 in Kenya and 2005 in Ethiopia, when there was some drought—but this would have affected both population types, as they are selected from the same regions.

Wasting prevalences among IDP tended to follow those of the surrounding population but usually were significantly higher (within country and pooled) (**table 2B**); the average increase was 3 percentage points overall. Surveys of IDP were done mainly in Somalia (n = 25) and Uganda (n = 57) (**table 1B**). In Somalia (**table 2B**), the prevalence was raised by 4 percentage points (p <. 05) compared with agriculturalists and by less compared with the average. In Uganda, the increase was smaller and not significant (**table 2B**). Malnutrition is thus somewhat increased in IDP, but the size of the increase was less than, for example, between years or different livelihoods. In the 30 surveys of returnee groups (i.e., previously displaced) in the dataset, no significant difference in wasting prevalence was seen compared with the overall population.

In Kenya, the urban surveys were primarily of migrants displaced by stock losses to small towns—many in Turkana in Kakuma, Kalokol, Kerio, Lokichar, and Lokichokio. The prevalence of wasting was similar to that among pastoralists (**tables 2B and 3**) and was higher than that among agropastoralists. These populations are of concern because of growing dependence on food distribution and poor prospects of resuming their livelihood due to lack of viable livestock herds.

Over the region covered by the surveys taken as a whole, 2001 and 2004 were the best years; using 2004 for comparison and controlling for country and other covariates (**table 2A**), average increases in wasting prevalences were 4.7 percentage points in 2000, 2.7 percentage points in 2003, and 2.1 percentage points

TABLE 4. Adjusted mean wasting prevalence (%) by country and year (numbers of survey results in parentheses).

Year	Kenya	Somalia	Sudan	Ethiopia (Afar and Somali)	Ethiopia (other regions)	Uganda	Eritrea	All (adjusted 1)[a]	All (adjusted 2)[b]
2000	24.3 (45)	16.1 (16)	13.0 (2)	21.1 (18)	12.3 (16)	10.8 (1)	—	18.0 (98)	16.3 (98)
2001	15.0 (37)	20.5 (8)	20.7 (22)	19.5 (6)	9.8 (16)	5.5 (4)	—	13.2 (93)	15.2 (93)
2002	16.1 (15)	12.5 (12)	26.4 (29)	22.2 (11)	9.2 (81)	—	—	15.0 (148)	17.3 (148)
2003	23.5 (13)	14.6 (13)	21.4 (37)	17.8 (11)	10.2 (83)	15.8 (21)	—	15.8 (178)	17.2 (178)
2004	16.6 (16)	17.0 (21)	19.5 (29)	12.4 (9)	9.0 (54)	7.5 (37)	—	13.3 (166)	13.7 (166)
2005	17.6 (17)	8.3 (4)	20.4 (21)	16.2 (7)	11.0 (36)	5.6 (20)	—	13.5 (105)	13.2 (105)
2006	23.1 (16)	5.9 (15)	25.8 (2)	19.3 (9)	10.2 (24)	4.3 (10)	15.8 (11)	15.3 (87)	16.1 (87)
All (unadjusted)	20.5 (159)	16.1 (89)	20.9 (142)	18.6 (71)	9.6 (310)	9.3 (93)	15.8 (11)	14.8 (864)	14.8 (864)

a. Adjusted for country, livelihood, and season.
b. Adjusted for livelihood and season.

in 2006. Prevalences by country and year (adjusted for season and livelihood) are shown in **table 4**. In Kenya, Somalia, Southern Sudan, and Ethiopia (Afar and Somali regions), the populations live mainly in arid or semiarid environments and are substantially livestock-dependent; in Ethiopia (other regions) and Uganda, agricultural livelihoods predominate. The factor-of-two difference in the average prevalence of wasting between these two (about 20% vs. 10%) probably reflects this difference in livelihood. Further, the arid and semiarid areas tend to have greater variation between years—e.g., 9 percentage points in Kenya vs. 3 percentage points in Ethiopia (other regions).

Seasonal changes in food security and health are expected to affect wasting prevalences, even without severe shortages, but the extent of typical changes is not well known because of lack of data. The data accumulated here provide an unusual opportunity to quantify seasonality of malnutrition, although (again) the nonrandom timing and location of surveys requires adjustment for measured factors and caution in interpretation. The overall effect of season can be seen from the regression model in **table 2A** as about 2 percentage points on average for the hunger season. However, this effect is not consistent across countries (**table 2B**). The relatively small size of the effect may be due to uncertainties in defining seasons, year-to-year variations in timing of seasons, and to loss of detail with aggregation within countries.

Few areas had enough surveys to allow adequate comparisons through time within the area, from resampling the population. There were 53 surveys for the Somali region in Ethiopia and 64 for the Rift Valley in Kenya, with reasonable distribution over seasons and years. Seasons were recoded, as described in Methods, as cumulating periods (0 to 21) across the 6 years to study seasonal changes further. The pattern from the Somali Region, Ethiopia, is shown in **figure 4A**. Although fluctuations do appear, these are not always aligned as expected, such as increases in the hunger season. Pooling the data across the pastoral regions (Kenya, Somalia, Southern Sudan, and Ethiopia [Afar and Somali]) gives the pattern shown in **figure 4B**. This shows a similar picture, with the hunger season the worst in 2000 and 2002, which had the highest means recorded, at greater than 25% prevalence; in other years, peaks were not necessarily in the hunger season.

The size of the fluctuations within years by season is typically around 5 percentage points (best to worst season), although the fluctuations rose to as high as 10 percentage points in 2002 (**fig. 4B**, seasons 7 to 9). The seasonal fluctuations are greater in years that have overall higher prevalences—as expected, the worse seasons are associated with more deterioration in child nutrition. However, this difference is of the same order, perhaps somewhat less than the year-to-year changes, which can be of 10 percentage points or so (**tables 2B** and **4**).

An issue arises when surveys are repeated in similar areas, intended to assess whether conditions have continued to worsen, stabilized, or improved. How much change is credible?

Seasonal changes are typically around 5 percentage points and may be as much as 10 percentage points when conditions deteriorate. This effect is observed over (roughly) 4-month periods, as displayed in **figure 4A** and **B**. A concern is that resurveying in the same area can show much larger changes, although this is difficult to document, in part because the sampling frame is not usually well specified in reports (or indeed known), and partly because only a few areas have sufficient data to allow analysis. Data for which exact survey months were given were taken from the Rift Valley Province, Kenya (n = 64, 76% pastoral), the Somali Region, Ethiopia (n = 53, 43% of surveys defined as pastoral; however, this is mainly a pastoral area), and the Oromia Region, Ethiopia (n = 97, 35% pastoral, mainly agricultural). Prevalences are plotted against total months from January 2000 in **figure 5**.

In retrospect, these plots readily identify broad patterns. For instance, in early 2000, wasting prevalences were very high in both the Somali Region and the Rift Valley Province. Peaks of wasting prevalence were recorded for early 2001 (minor in the Rift Valley Province), 2002, and 2003 in both these areas, and a further peak was recorded in early 2004 in the Rift Valley Province. Some of these peaks reached 30% or higher, and in good years the prevalence could fall to 10% to 15%. In contrast, wasting prevalence in Oromia seldom reached 20% and usually fluctuated by about 5 percentage points around a mean of 10%. Note that we get more fluctuation in **figure 5** where each survey result is plotted, compared with the four-monthly seasonal averages given in **figure 4B**.

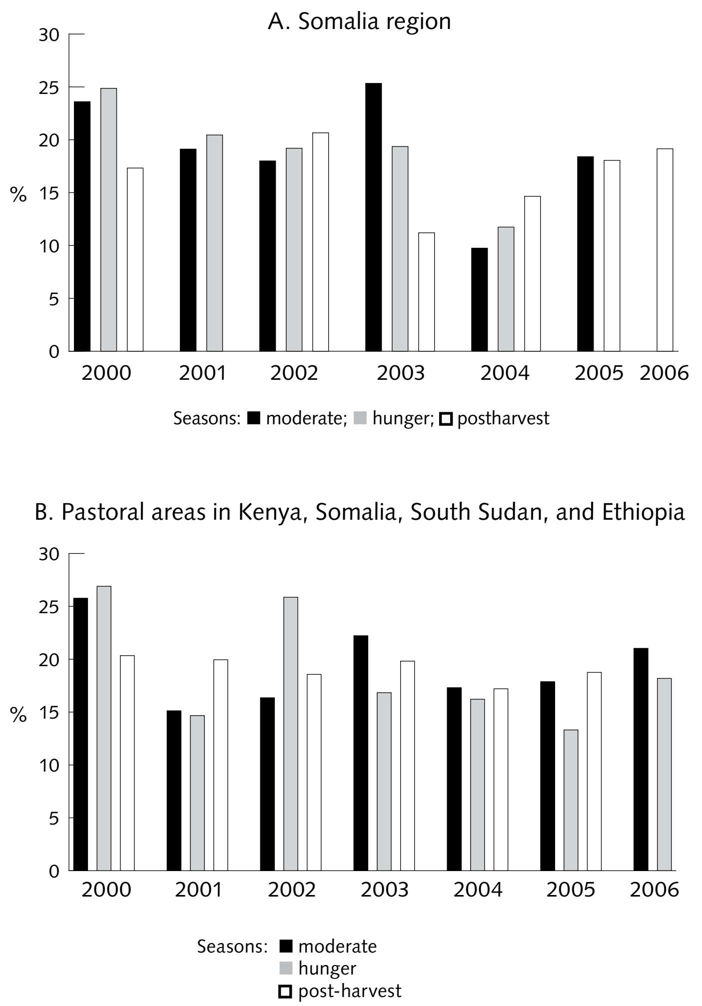

FIG. 4. Prevalence of wasting by season
Areas: surveys from Kenya (Northeastern, Eastern, and Rift Valley Provinces); Somalia (all); Southern Sudan (Bhar el Ghazal, Jonglei, Upper Nile, Equatoria); Ethiopia (Afar and Somali Regions).

The peaks of wasting in Ethiopia (Somali region, **figure 5A**) and in Rift Valley Province in Kenya (**figure 5B**), tended to be in the second quarter of the year, corresponding to the hunger season. In Oromia, the wasting prevalences were consistently lower, fluctuating between about 7% and 15%.

Discussion

What child wasting prevalences are typical and what changes represent deterioration? What signals show that intervention should be triggered, for different populations?

Years of drought (especially 2000 and 2005–06) were associated with an increase, averaging across surveys, of up to 8 percentage points in child wasting overall (e.g., 2000 compared with 2004: **table 2B**, "All"), and of a similar magnitude within countries (**tables 2B** and **4**)—with adjustment for livelihood and season, this was about 5 percentage points. However, these results need to be examined within livelihood groups.

Pastoralists

Wasting prevalences for pastoral children were typically around 17%, compared with 10% for agriculturalists or populations with mixed livelihoods. The prevalence usually changed by about 5 percentage points between better and worse seasons. Interpretation of survey results is facilitated by time series plots, such as those in **figure 5**. For the Somali Region of Ethiopia and the Rift Valley Province of Kenya—both mainly pastoral (**fig. 5A** and **B**)—the fluctuations were more pronounced between years than between seasons (as also seen in **table 2B**). Periods with relatively good nutritional status typically had prevalences of 10% to 20%; in periods with poor nutrition, prevalences rose to 25% to 40%. Thus, at prevalences above around 25%, wasting represents an unusual problem in these populations. Plotting new survey results as a continuation of a time series, such as in **figure 5**, may be valuable in facilitating future interpretation.

The timing is also relevant. In most instances, the peaks of wasting were in the hunger season in the first half of the year. Further, wasting prevalences that reached only 15% at this time were seldom followed by higher rates; conversely, when there were problems, the prevalences at this time were greater than 25% and were often up to 30% or 40%. This suggests that surveys should be deliberately timed for the early part of the year and that prevalences of 15% or less are unlikely to indicate an impending crisis, whereas prevalences above 25% are.

Agricultural and agro-pastoral populations

In these populations, the overall wasting prevalences are lower—around 10%—and subject to less fluctuation, year-to-year or seasonally. The results shown in **figure 5C** (Oromia) provide an illustration. The interpretation is not that Oromia had fewer nutritional problems, since growth patterns of pastoral and nonpastoral children differ significantly; if there were estimates of underweight or stunting, the impression would be different. However, the results suggest that wasting prevalences above 15% are unusual and probably are a signal that intervention is required in agricultural and mixed (agropastoral) livelihood groups, as are wasting prevalences above 25% in pastoralists.

Allowing for different growth patterns

Wasting provides only a partial indication of malnutrition. Growth measured by stunting compared with wasting from 0 to 5 years of age—as seen from national DHS/MICS data—diverges dramatically between different livelihood groups, as represented by Somalia and Uganda (**fig. 2**). Wasting prevalence decreases with better socioeconomic status in pastoralists (**fig. 3**), whereas the response to better socioeconomic status in agriculturalists tends to be decreased stunting prevalence. The different growth patterns of pastoralists and agriculturalists are related to different diets, for mothers during pregnancy and lactation, and for infants and young children. While cereals are important for children of agriculturalists, those of pastoralists have significant intakes of milk (and often cow's blood). When food is scarce, the milk and blood diet is likely to provide a low intake of energy but relatively high intakes of protein, iron, calcium, and other micronutrients, which will favor continued growth in height rather than in soft tissue. The opposite applies for agriculturalists: energy intake may be reduced, but diet quality (protein and micronutrients) decreases more, which would favor stunting.

Wasting prevalences are used in this context because age is not determined with any accuracy. It could be argued that if wasting was telling the full story—that

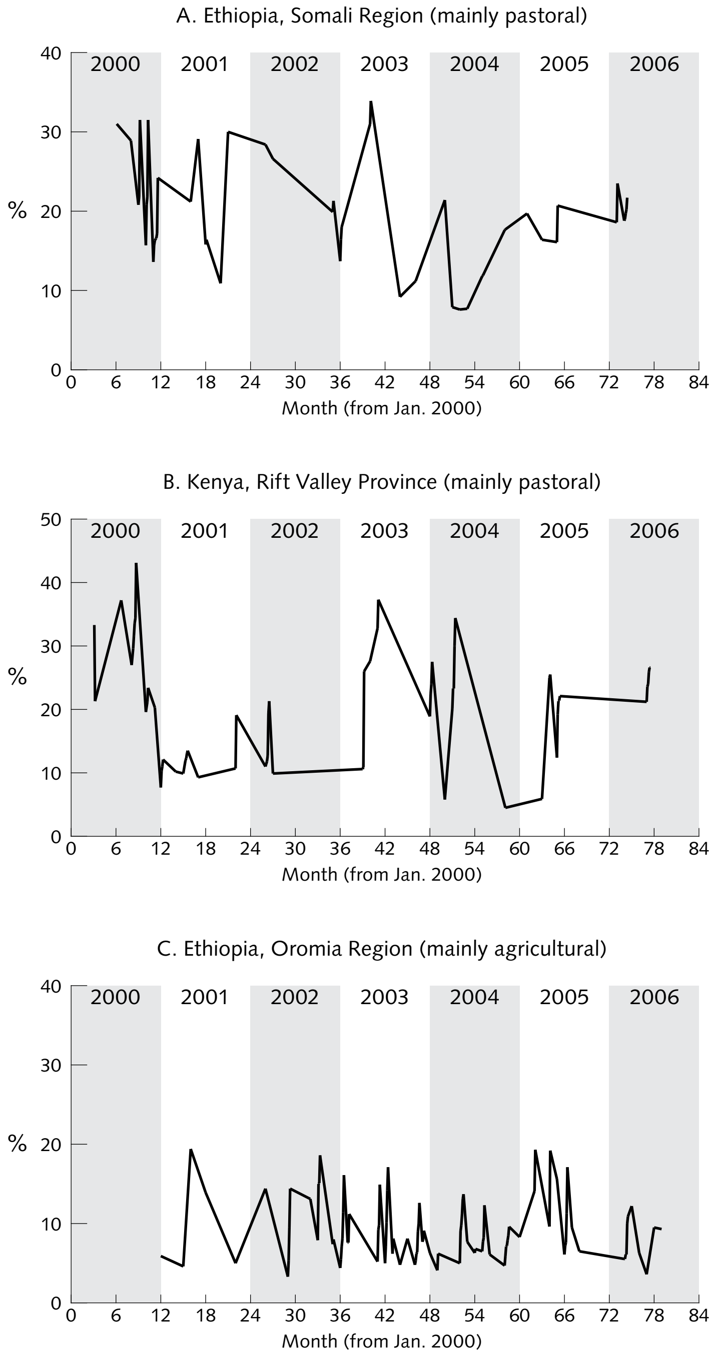

FIG. 5. Prevalence of wasting. Each point is a survey result

pastoral children are more malnourished—they would be more stunted, which they are not. To further examine the implications of differences in wasting levels between populations needs data on causal factors (food security, health) or on risks to be averted (e.g., mortality); these are discussed in the next paper in this series [24].

Implications for timely warning for intervention to mitigate malnutrition

Given the difference in growth patterns by livelihood, *different criteria are needed in evaluating wasting prevalences*. From these results, rules for interpretation are suggested as follows, for vulnerable populations in the Greater Horn of Africa:

» Among *pastoral* child populations, wasting prevalences of up to 15% or 20% are not indicative of unusual conditions, but prevalences above 25% indicate a possible emergency.
» Among *agricultural* (or mixed agropastoral) populations, wasting prevalences of up to 10% are not uncommon, although around 5% is more normal; prevalence above 15% does suggest the need for concern and possible intervention.
» Wasting prevalences can increase rapidly, particularly in the dry season; surveys should be done in the dry season (early part of the year), and setting them in the context of a historical time series (as in **fig. 5**) should help interpretation.

Displacement and migration

The survey data available suggest that IDP were only marginally more malnourished than the surrounding population. Returnee populations were not more malnourished. Groups that had migrated to small towns in North Eastern Kenya—mostly in Turkana in the surveys—were similar in wasting prevalences to the pastoral populations outside towns but were of particular concern, as they were becoming dependent on food distribution and were without viable livestock herds to allow re-establishment of normal livelihoods.

Next steps

Although the current practice of multiple small-scale surveys (with sample sizes around 1,000) provides useful information, a move toward more regular reporting could substitute for some of the surveys. For example, reporting from clinics and regular surveys of sentinel areas, such as those undertaken by the arid and semiarid lands project (ASAL) in North Eastern Kenya, could provide underlying monitoring, allowing fewer surveys to be launched in response to other signs of problems, such as drought reports and population movements. Survey methods themselves could be improved, especially if fewer surveys meant more resources available per survey. Priorities would include better sampling methods and, in some cases, investing in better age determination to allow estimates of stunting and underweight.

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Identifying priorities for emergency intervention from child wasting and mortality estimates in vulnerable areas of the Horn of Africa

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Abstract

Background. *The relation between anthropometric measures and mortality risk in different populations can provide a basis for deciding how malnutrition prevalences should be interpreted.*

Objective. *To assess criteria for deciding on needs for emergency interventions in the Horn of Africa based on associations between child wasting and mortality from 2000 to 2005.*

Methods. *Data were analyzed on child global acute malnutrition (GAM) prevalences and mortality estimates from about 900 area-level nutrition surveys from Ethiopia, Kenya, Somalia, Sudan, and Uganda; data on drought, floods, and food insecurity were added for Kenya (Rift Valley) and Ethiopia, from Food and Agriculture Organization (FAO) reports at the time.*

Results. *Higher rates of GAM were associated with increased mortality of children under 5 years of age (U5MR), more strongly among populations with pastoral livelihoods than with agricultural livelihoods. In all groups spikes of GAM and U5MR corresponded with drought (and floods). Different GAM cutoff points are needed for different populations. For example, to identify 75% of U5MRs above 2/10,000/day, the GAM cutoff point ranged from 20% GAM in the Rift Valley (Kenya) to 8% in Oromia or SNNPR (Ethiopia).*

Conclusions. *Survey results should be displayed as time series within geographic areas. Variable GAM cutoff points should be used, depending on livelihood or location. For example, a GAM cutoff point of 15% may be appropriate for pastoral groups and 10% for agricultural livelihood groups. This gives a basis for re-examining the guidelines currently used for interpreting wasting (or GAM) prevalences in terms of implications for intervention.*

Key words: Africa, child mortality, humanitarian intervention, malnutrition

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Background

Prevalences of wasting (or GAM*) differ markedly between populations within the Horn of Africa, under drought conditions and in normal times. This raises the operationally important question as to whether prevalences should be interpreted the same or differently between different populations, for example, between pastoralists and agriculturalists, when judging needs for intervention. One approach is to consider the relation between anthropometric measures and mortality risk, assuming that mortality risk should have the same implications for intervention needs across different population groups.

The relation between mortality and child malnutrition was established in prospective meta-analyses [1]. These showed that the mortality risk for a given weight-for-age deficit differed between countries; for example, the mortality rate associated with 60% to 69% weight-for-age (about equivalent to −3 to −4 SD) was around 20/1,000/year in India and Bangladesh and 50 to 70/1,000/year in Tanzania and Malawi (fig. 4.4 on

* Global acute malnutrition (GAM) is the combined prevalence of < −2 SD weight-for-height z-scores (WHZ) plus edema; since edema prevalences are rarely more than 1%, GAM is close to conventional wasting prevalences. The available indicator is thus GAM, almost all of which is wasting.

p 2052S of Pelletier [1]). National estimates of child malnutrition prevalences are usually higher in South Asia than in Africa, but child mortality rates are lower in Asia. For example, in the early 2000s, India had a child mortality rate of 87/1,000 live births and a child underweight prevalence of 47%; Kenya had a child mortality rate of 123/1,000 live births and a child underweight prevalence of 20% [2]. Thus, relations between child mortality and anthropometry can differ between different populations.

The purpose of the studies reported here is to explore the relationship between wasting (as GAM) and child mortality estimates in different populations in vulnerable areas of Kenya, Somalia, Sudan, Ethiopia, and Uganda. The main purpose is to assess how GAM is associated with child mortality, and what prevalence levels could be used to decide on needs for emergency humanitarian interventions.

The current criteria for deciding on the severity of emergencies include food security indicators, wasting prevalence, and mortality rates (either crude all-age mortality or mortality among children under 5 years of age)—these are key components of the set of indicators for the Horn of Africa used by the Food Security Analysis Unit [3], for example. These criteria are usually applied to all populations irrespective of livelihood or usual child growth patterns, which makes sense for mortality but implies that malnutrition indicators have the same relation to risk for all populations.

Interpretation of prevalences of wasting (< –2 SD weight-for-height z-scores [WHZ] in children under 5 years of age) is suggested by the World Health Organization (WHO) [4] for all populations as follows: < 5%, acceptable; 5–9.9%, poor; 10–14.9%, serious; > 15% critical. This is widely echoed (e.g., CDC/SAVE [5]), and 15% wasting has come to be quoted as the "WHO emergency cut-off" (e.g., IRIN [6], USAID/OFDA [7]). The United Nations Standing Committee on Nutrition [8] now refers to 10% wasting as serious; previously, 20% was "undoubtedly high" and 40% indicated a severe crisis in 1994 [9]. Médecins sans Frontières [10] uses 10% wasting, as does UNICEF [11].

Mortality estimates in emergency settings, and in the surveys analyzed here, are from short recall periods (usually 90 days), calculated as deaths/10,000/day. For under-five children in particular, these are distinct from the "under-five mortality rates" widely quoted as basic statistics in terms of deaths per 1,000 live births, which give estimates of probability of survival from birth to age five, obtained from Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and other large-scale (usually national) surveys. This distinction must be kept clear (as stressed by SMART [12]), and the two estimates are not readily comparable. Conventionally, the value expressed as deaths/10,000/day refers to estimates from small-scale surveys with short recall periods and is most relevant for assessment of potential emergencies. Here the estimate of under-five mortality in child deaths/10,000/day is referred to as U5MR because of its familiarity; it is equivalent to the "0–5 death rate" put forward in the SMART handbook [12], which also notes that the 0–5 death rate is generally about twice the overall (all-age) mortality rate (p 22).

The trigger level of mortality rate (crude all-age mortality [CMR]) proposed as indicative of an emergency is 1/10,000/day, originated by the Centers for Disease Control and Prevention (CDC) [13], with 2/10,000/day as "an emergency out of control." This has also been widely adopted (e.g., Sphere [14]), with the equivalent trigger levels for U5MR of 2/10,000/day and 4/10,000/day; usual levels of U5MR in Africa are about 1/10,000/day [8]. Another interpretation uses the idea of factors, usually doubling, of baseline or underlying rates (e.g., SMART [12], ACC-SCN [9], and United Nations Standing Committee on Nutrition reports [8]); for U5MR in Africa, a doubling again suggests about 2/10,000/day as a trigger point.

The Integrated Phase Classification put forward for interpreting data from Somalia [3] combines a set of indicators including mortality and wasting, as follows (in brief): phase 2 (or better)—U5MR < 1/10,000/day and wasting < 10%; phase 3 ("acute food and livelihood crisis")—U5MR 1–2/10,000/day and wasting 10–15%; phase 4 ("humanitarian emergency")—U5MR > 2/10,000/day and wasting > 15%; phase 5 ("famine/humanitarian catastrophe")—CMR > 2/10,000/day (likely to be equivalent to U5MR > 4/10,000/day) and wasting > 30%.

Data were available from about 900 small-scale surveys done in 2000–06, of which almost half contained child mortality estimates. A full report of data and analyses is given in Chotard et al. [15]. These surveys were often done in response to concerns for deteriorating nutritional conditions and thus do not necessarily represent "normal" situations. However, the relations between mortality and malnutrition are assessed in circumstances where interpretation in terms of intervention needs is most relevant. This paper suggests how data may be displayed in relation to previous trends and proposes modified criteria for deciding on interpretation for emergency interventions. The common factor across different populations could be mortality risk rather than malnutrition itself.

Data and methods

The data were originally extracted from reports of about 900 small-scale surveys (area level) carried out in Ethiopia, Kenya, Somalia, Sudan, and Uganda between 2000 and 2006. These have been described in Chotard et al. [15, 16], together with derivation of many of the variables used in the analyses reported here. The outcome variables were estimated U5MR and the prevalences of wasting (< –2 SD WHZ) and edema (these were reported together and could not be separated), also referred to as "global acute malnutrition" or GAM. The age group consisted of children either under 5 years of age or under 110 cm in height.

A total of 897 valid GAM cases and 474 U5MR cases (all but one with GAM also) were in the original dataset, 473 cases with both GAM and U5MR. The studies focused on 2000–05, since a number of the surveys in 2006 were conducted specifically on populations recorded as receiving food aid, and the 73 cases from 2006 were excluded. U5MR values above 7.0/10,000/day were excluded ($n = 6$). Populations from urban areas ($n = 34$) and internally displaced people (IDP) ($n = 59$) were treated as separate groups and were excluded from the analyses reported here. A total of 316 valid cases with GAM and U5MR values were included in the working dataset (a few of the exclusions overlapped). Prevalences of low arm circumference were available in only 54 cases, 48 also with U5MR, which was insufficient for analysis (within these there was no association with U5MR), and analysis of low arm circumference was not pursued further. The prevalence of severe acute malnutrition (SAM) (< –3 SD WHZ) was highly correlated with GAM and overall had somewhat less association with U5MR, and SAM was not investigated further in these analyses; one consideration is that the lower prevalences of SAM (mean, 2.2%; $n = 656$) lead to increased uncertainty in the estimates.

Mortality estimates

Estimates of mortality were usually obtained by questionnaire with a 90-day recall, essentially listing household members at the start and end of the period and determining which had died. The formats are similar in different surveys; examples are from the UNICEF/MICS Child Mortality Module [17] and SMART [12], and a summary of methods in use for these surveys is given in Conkle [18]. The results are expressed as deaths/10,000/day, and the main indicator used here is for children defined as under 5 years of age (U5MR). Although mortality estimates by this method have wide confidence intervals, there was no reason to suppose these were systematically biased, so that analysis using the point estimates was considered feasible, given the large number of surveys.

Drought, floods, and food insecurity

Estimates related to food insecurity were extracted from the Food and Agriculture Organization (FAO) Global Information and Early Warning System reports on Foodcrops and Shortages put out at the time [19], retrieved from http://www.fao.org/giews/english/fs/index.htm and searched within the "Situation by Country" section for reference to specific regions within Ethiopia (Oromia, and Somali-Afar) and Kenya (Rift Valley Province). Three to five reports per year were issued and are available. Conditions were coded for severity (0 to 5, good to severe) under three headings: drought conditions; effects of drought on food availability, including causing affected populations to migrate; and floods. These were scored independently by two researchers, and when scores differed they were reassessed; the coding was done without knowledge of the wasting or U5MR data. This gave three new variables: *drought, effect, flood,* in Excel. As these were not generally coincident with survey timings, the data were not merged but were plotted separately and compared with survey outcomes by inspection (**fig. 2C–E**).

Results

Comparing fluctuations in U5MR and GAM over time

GAM and U5MR generally moved in the same directions, as seen in **figure 1A** as averages by country or aggregated regions (Ethiopia), and year. These results are shown by livelihood group in **figure 1B**. These GAM and U5MR estimates also tended to move in the same direction, and the levels remained distinct between the high and low (GAM and U5MR) groups across time. Thus, Kenya, Sudan, and Ethiopia (Afar and Somali) had GAMs around 15% to 20%, and Ethiopia (Amhara, Oromia, SNNPR, and Tigray) was in the 8% to 12% range; U5MRs were 1.5 to 2.5/10,000/day in the first group and about 0.8 to 1.2/10,000/day in the second. Pastoralists had average GAMs around 15% and U5MRs about 1.4 to 1.9/10,000/day; agropastoralists had average GAMs about 10% and U5MRs about 1.2 to 1.8/10,000/day; and agriculturalists had average GAMs of 10% or less and U5MRs about 0.7 to 1.4/10,000/day. These results are related, as the group of Kenya, Sudan, and Ethiopia (Afar and Somali) is largely pastoral, and Ethiopia (Amhara, Oromia, SNNPR, and Tigray) has a majority of agriculturalists.

How the GAM and U5MR estimates are related through time, survey-by-survey, can be seen in **figure 2A** for Kenya and **2B** for Ethiopia (Amhara, Oromia, SNNPR, and Tigray). (Other areas had too few data points.) These figures select available cases that have data for both U5MR and GAM.

The data from Kenya ($n = 45$, of which 32 are from the Rift Valley Province) show considerable correspondence between spikes of high GAM and high U5MR. By inspection, U5MR above 2.0/10,000/day seems to be associated with GAM above around 20%, from a usual level of GAM of around 10%. Elevated U5MR (> 2.0/10,000/day) is hardly ever seen without

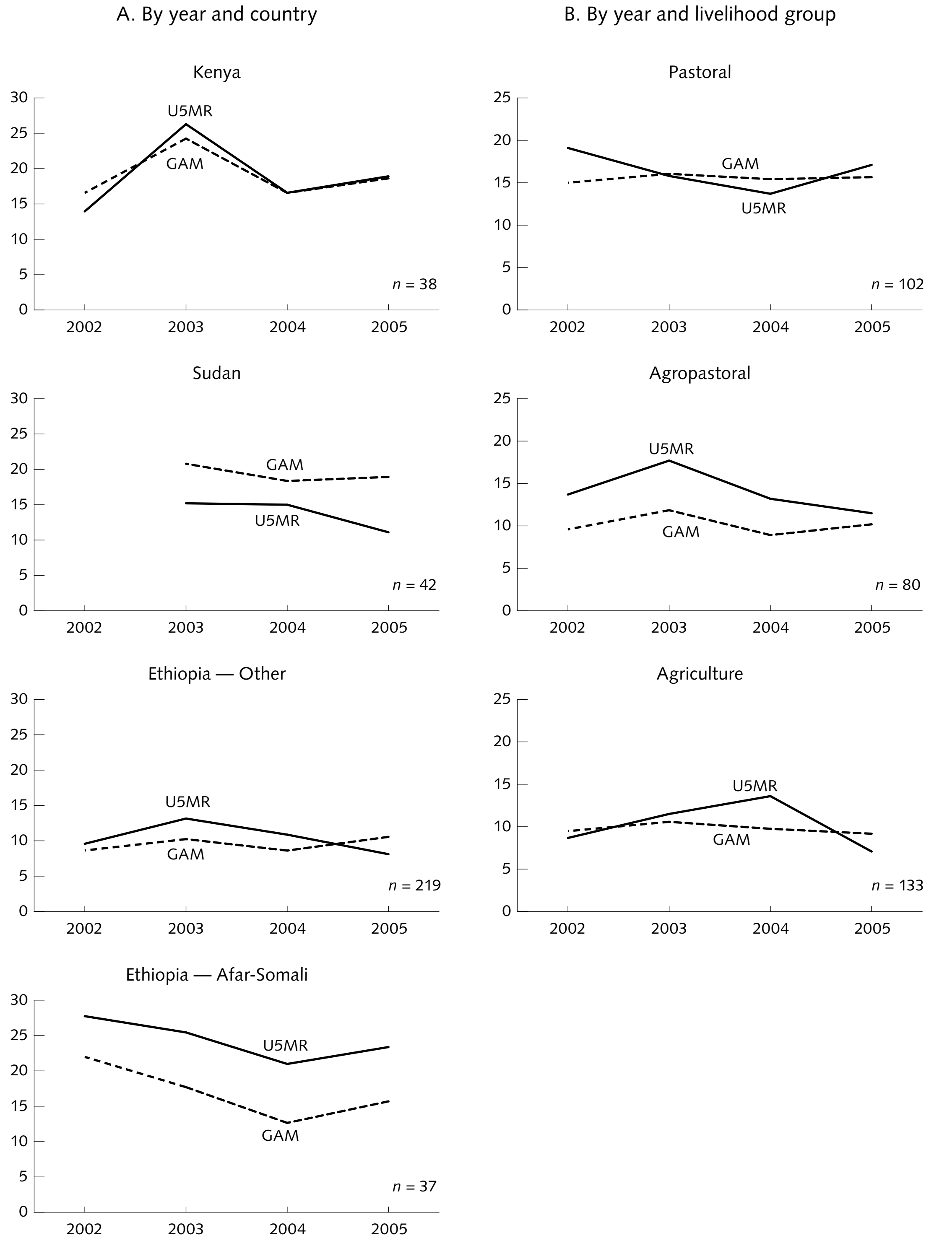

FIG. 1. Average global acute malnutrition (GAM) and under-five mortality rate (U5MR). U5MR is shown in deaths/100,000/day for ease of plotting; elsewhere the indicator is deaths/10,000/day, as usual

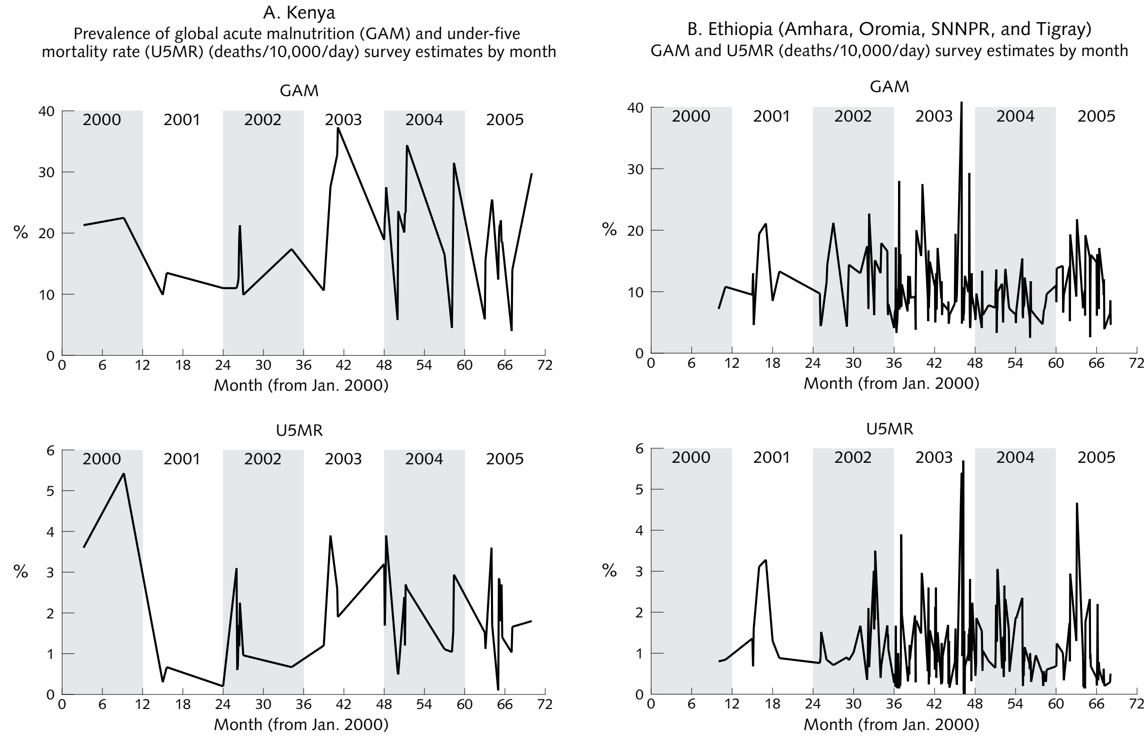

FIG. 2. Malnutrition (GAM) and child mortality (U5MR) plotted as time-series by month, and correspondence with food security indicators in selected areas.

concomitant elevated GAM (> 20%), and rarely is elevated GAM not associated with elevated U5MR (one example is the last data point, at the end of 2005).

The data from Ethiopia (Amhara, Oromia, SNNPR, and Tigray: excluding the more pastoral groups in Afar and Somali) in **figure 2B** also show considerable correspondence, although less than the data from Kenya, and at different levels. Here the prevalence of GAM that appears to be associated with elevated U5MR is nearer 15%, from a usual range of 5% to 10%; selecting values above 20% GAM would identify very few cases. Elevated U5MR is often associated with GAM prevalence above 15%—as in 2001, 2003, and 2005—but, for example, in 2004 U5MR was greater than 2.0/10,000/day without raised GAM; and in 2002 GAM was high with low U5MR. Thus, in this population the correspondence appears less than in Kenya (**fig. 2A**).

The picture within livelihood groups is similar (data not shown). Among pastoralists, the correspondence is high, with a threshold of 20% GAM clearly associated with U5MR above 2.0/10,000/day. The correspondence appears less among agriculturalists—similar to Ethiopia (Amhara, Oromia, SNNPR, and Tigray), where agriculture is the majority livelihood—with a threshold apparently around 15%. Agropastoralists are intermediate.

How do drought indicators relate to wasting (GAM) and child mortality (U5MR)?

Reports on drought conditions were extracted from the FAO Global Information and Early Warning System for the Rift Valley Province in Kenya, and the Oromia and Somali regions (separately) in Ethiopia. The question is: How far do outcome measures (wasting and child mortality) appear to respond to drought (and floods) and related food and health stresses? The data on drought and outcomes have similar timing, in that surveys were usually launched because of concerns for drought and food insecurity. The two sources—drought reports and wasting and mortality outcomes—are, however quite independent. The data were first examined by plotting with parallel time axes, as shown in **figure 2C–E**.

In the Rift Valley (**fig. 2C**), the sequence may be described along the following lines. Drought was severe in 2000, with serious effects on food security (both “drought” and “effect”—meaning reported impact of drought—are high in months 0 to 12). This corresponded to very high GAM, rising to greater than 40% in one survey. The one U5MR estimate (early in the year) was also very high at nearly 4/10,000/day. The drought lessened in 2001, and rainfall was good into early 2002, but reports of the continuing effects of the 2000 drought were that this remained serious until early 2003 (“effects” line). Both GAM and U5MR

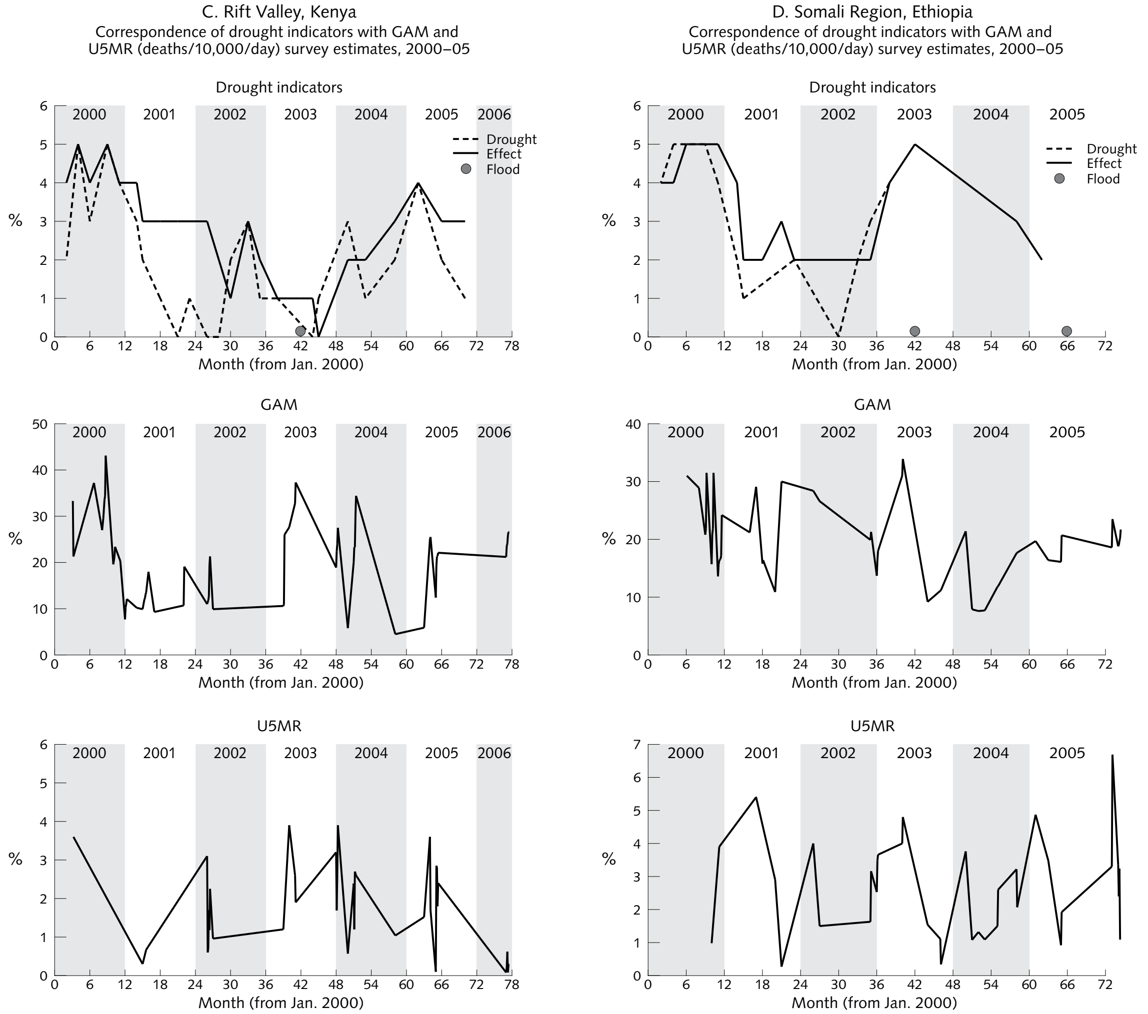

FIG. 2. Malnutrition (GAM) and child mortality (U5MR) plotted as time-series by month, and correspondence with food security indicators in selected areas. *(continued)*

were much lower in 2001, and both spiked upwards in early 2002. There was no drought in 2003, and lingering effects were low. However, GAM and U5MR were substantially raised, and this corresponded to—and was presumably caused by—floods reported in June 2003. In 2004, the pattern of drought and its effects on GAM continued, with U5MR raised in the first half of the year; for the second half of the year, there are few survey data, but they show low GAM and U5MR, despite drought and its effects. However, by mid-2005 the drought effects were severe, and GAM and U5MR were again raised.

In the Somali Region of Ethiopia, which is also mainly pastoral, the levels of GAM and U5MR were similar to those in the Rift Valley (**fig. 2D**), with a similar relationship. What is striking is that the floods of mid-2003, reported as having a major effect on food security (and health), were reflected in very high prevalences of GAM (30% to 40%) and U5MRs up to 5/10,000/day. Reports of drought conditions are sparse for 2004–05.

The Oromia Region of Ethiopia is more agricultural and less drought-prone (**fig. 2E**). Here the prevalence of GAM was generally much lower than in the other two regions examined, often less than 10%, and the usual levels of U5MR were also lower, frequently less than 1/10,000/day. Drought in 2000 receded in 2001, and early 2002 had good rainfall. U5MRs appear to reflect this change better than GAM, but data are scarce for this period. From mid-2002, drought returned, and GAM and U5MR were somewhat elevated in certain surveys, but not strikingly so. Drought was reported much less frequently from 2003 on. GAM and U5MR were reasonably coincident with each other (as also seen in **fig. 2B**), but reports on drought conditions are insufficient to examine correlations—this was at a time when there was indeed less drought—and the continuing spikes of raised GAM and U5MR were presumably

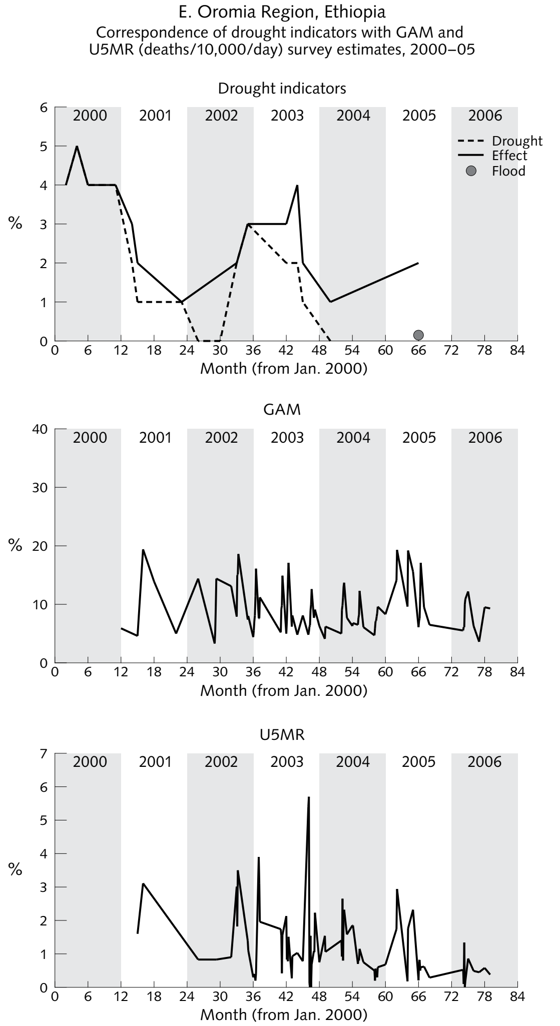

FIG. 2. Malnutrition (GAM) and child mortality (U5MR) plotted as time-series by month, and correspondence with food security indicators in selected areas. *(continued)*

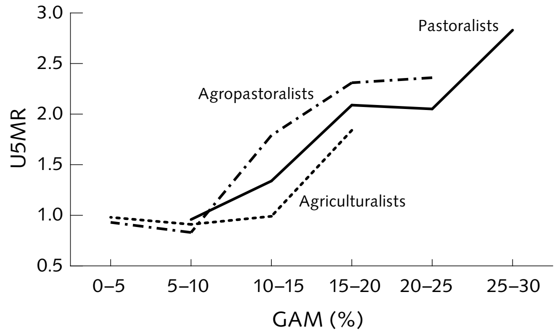

FIG. 3. Mean under-five mortality rate (U5MR) (deaths/10,000/day) by band of global acute malnutrition (GAM) and by livelihood group. Points with $n \leq 3$ are excluded. Regression for GAM ≥ 10% to < 25% (U5MR and GAM as continuous variables): agropastoralists compared with agriculturalists, B = 0.63, p = .002; pastoralists, NS different from other groups; interactions NS; for GAM, B = 0.083, p = .000

due to other factors, including seasonal stresses early in the year.

Overall, these results indicate that correlations between drought (and floods) and their food security effects may be strong in pastoral communities, so that GAM may be effective in detecting drought effects and in predicting mortality risk. This may be less so for agricultural communities, which also usually have lower GAM and U5MR rates. The predictive value of GAM for U5MR is now examined more formally.

Relations between GAM and U5MR by population group

The relation between U5MR and GAM is seen to be nonlinear by plotting mean U5MR by band of GAM, as shown in **figure 3**, by livelihood group. Mean U5MR is unchanged between the 0% to 5% and the 5% to 10% GAM prevalence bands for pastoralists and agropastoralists, and up to 10% to 15% GAM for agriculturalists. The U5MR then increases with increasing GAM, to about 2.5/10,000/day in pastoralists and agropastoralists and 1.8/10,000/day in agriculturalists. On the basis of linear regression testing between 10% and 25% GAM, agropastoralists have significantly (p = .002) higher U5MR for GAM than agriculturalists; the equivalent dummy variable for pastoralists compared with agriculturalists has p = .15. After the 5% to 10% GAM band, at all GAM values agropastoralists and pastoralists have higher U5MR than agriculturalists.

For program decisions, key questions concern how to interpret GAM in terms of priority for intervention. When the concern is for preventing the effects of severe malnutrition through emergency intervention, a major aim is to prevent child mortality. These priorities can apply *within* population groups—should we launch an intervention or not?—and to comparing *between* groups—where is the greatest need? GAM predictions of child mortality can be used to calibrate GAM for interpretation; this may then be transferred to interpreting survey results where only GAM and not U5MR has been measured (e.g., in about half of all the surveys available for these studies).

The discriminatory power of GAM in identifying elevated U5MR was investigated next with U5MR dichotomized at 2.0 and 1.5/10,000/day, compared with GAM prevalences increasing in steps of 2.5%, up to 25%. A U5MR cutoff at 2.0/10,000/day was the main focus. Treating U5MR as the outcome to be predicted, sensitivity (Se), specificity (Sp), and positive predictive value (PPV) were calculated. The sum of Se + Sp gives an estimate of the extent to which the diagnostic variable (GAM here) identifies the outcome of concern (U5MR > 2.0/10,000/day here), and the cutoff point at which this is maximized.

An example of such calculations is given in **table 1** from Kenya, with GAM cut at 20% and U5MR at 2.0/10,000/day. In this case, there were 18 surveys reporting raised U5MR, of a total of 45 surveys (40%); 14 of these would be identified using the GAM cutoff point of 20% (i.e., Se = 0.77). If the 22 surveys with GAM greater than 20% were chosen for intervention, 14 of these (64%) would have elevated U5MR, and 8 would be false positives (i.e., PPV = 0.64). The discrimination at this cut-point is indicated as the Se + Sp of 1.47, meaning that the selection is 47% better than random. The four cases of elevated mortality missed, having GAM less than 20%, would be identified by lowering the cutoff point, but at the cost of lowering the specificity or including more false positives. Repeating this process for different cutoff points and for other groups allows assessment of how effective GAM is in identifying elevated U5MR populations.

Similar results by livelihood group are shown in **table 2**. This demonstrates that GAM can significantly identify populations with elevated U5MR, at 40% to 55% better than random selection, at cutoff points from 10% to 15% GAM, depending on the group.

TABLE 1. Example of correspondence between U5MR and GAM (at cutoff point of 20%), for surveys from Kenya, 2000–05[a]

GAM	U5MR ≥ 2.0	U5MR < 2.0	Total
≥ 20%	14	8	22
< 20%	4	19	23
Total	18	27	45

GAM, global acute malnutrition; PPV, positive predictive value; Se, sensitivity; Sp, specificity; U5MR, under-five mortality rate (deaths/10,000/day)

a. Se = 14/18 = 0.77, Sp = 19/27 = 0.70, PPV = 14/22 = 0.64, Se + Sp = 1.47, chi-squared = 10.02, *p* = .002.

Intervention priorities from a set of survey results

Several operationally relevant questions can be addressed from these data. As survey results come in, what priority do they indicate for intervention? It would be logical to start with the highest and most worrisome prevalences and ask specific questions, such as: What prevalence cutoff point should be used that would (according to the historical data) ensure that 75% (or 50%, etc.) of the populations with elevated U5MR are correctly identified? This applies either if mortality is not estimated, as in about half the surveys, or if the mortality estimate is to be evaluated. This cutoff point is likely to vary by livelihood group or location, and these will be examined separately.

The first relevant statistic is the sensitivity—that is, the proportion of true cases (elevated U5MR) that are identified; in the illustration in **table 1**, this (Se) is 14/18, with 4 false negatives. The Se values are plotted by livelihood group in **figure 4A** and by geographic location in **figure 4B**. Reading horizontally (top graph in **fig. 4A**), the GAM prevalence corresponding to 50% of U5MR greater than 2.0/10,000/day found (*y*-axis) can be seen as just below 20% for pastoralists, around 15% for agriculturalists, and about 13% for agropastoralists. By area (**fig. 4B**), an example is that 75% of populations with elevated (> 2.0/10,000/day) U5MR are identified at just above 20% GAM in the Rift Valley Province in Kenya, compared with about 8% GAM in Oromia or SNNP in Ethiopia. Analogous results are shown in the lower charts for detecting U5MR greater than 1.5.

The full set of estimates is given in **table 3**, for U5MR cutoff points at 2.0 and 1.5/10,000/day, showing GAM prevalence cutoff points that would identify 75% and 50% of the elevated U5MR cases. This table also shows the proportion of all the cases selected at these GAM cutoff points that are actually of elevated U5MR (PPV)—in the illustration in **table 1**, that is 14 out 22 cases with GAM above 20%.

This means that for a given area or livelihood group, a set of GAM prevalence results can be sorted into those indicating a need for intervention and those not so identified. It can also show the probability that those included actually do have elevated mortality. For example, if four surveys from the Rift Valley Province showed prevalences of 25%, 21%, 18%, and 14%, and the aim is to identify 75% of actual high- mortality cases, then the first two should be selected for intervention (above 20%), and the probability that these are true cases (PPV) is 0.72. The cutoff points are very different for Oromia and SNNPR, at 7.5% for the same criteria,

TABLE 2. Maximum sensitivity plus specificity for GAM identifying elevated U5MR (> 2.0), by livelihood group

Livelihood	*n*	GAM cutoff point at maximum Se + Sp[a]	Maximum Se + Sp	Chi-square, *p*, at GAM cutoff point
Pastoral	96	15%	1.46	16.7, 0.000
Agropastoral	79	10%	1.55	20.5, 0.000
Agricultural	132	15%	1.40	15.8, 0.000

GAM, global acute malnutrition; Se, sensitivity; Sp, specificity; U5MR, under-five mortality rate (deaths/10,000/day)

a. Steps of 2.5% were tested.

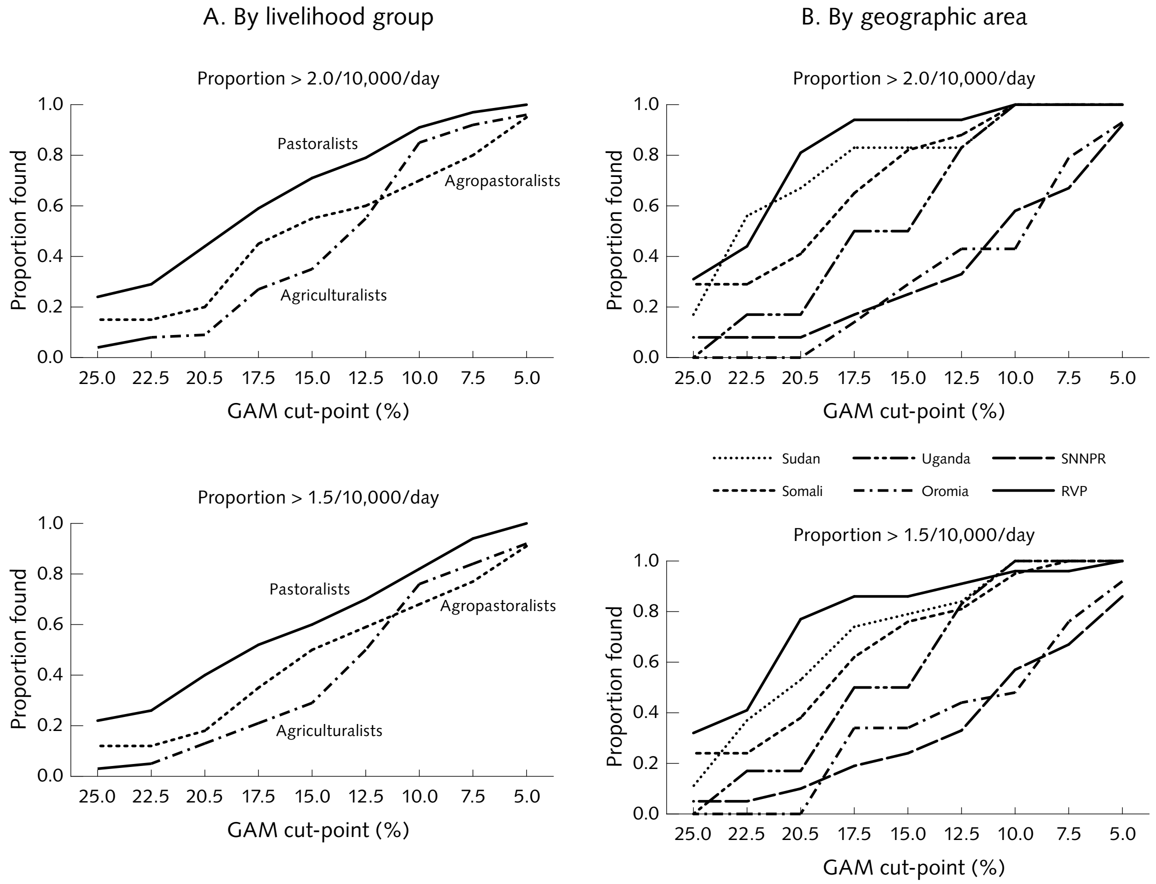

FIG. 4. Sensitivity of global acute malnutrition (GAM) in identifying elevated under-five mortality rate (U5MR) (> 2.0 or > 1.5/10,000/day)

and the probability of correct selection is much lower (0.18 to 0.22)—this is related to the overall much lower mortality in Oromia and SNNPR.

For the Rift Valley Province, 48.5% of the surveys showed elevated mortality (third to the last column of **table 3B**). Thus, the PPV of 0.70 is (0.7/0.485 = 1.44) 44% better than random; for Oromia this value is about 32%. These ratios of PPV to elevated mortality cases (using GAM cutoff point to find 50% of elevated U5MR) are given in the second to the last column of **table 3**.

To find a majority of the elevated U5MR cases, GAM cutoff points therefore need to be much lower for Oromia and SNNPR (and/or for agricultural populations) than for Rift Valley Province, the Somali Region, or Sudan (and/or with substantial pastoralism): roughly 7.5% for Oromia and SNNPR, compared with 15% to 20% for the Rift Valley Province, the Somali Region, or Sudan, i.e., about half.

Mortality by band of GAM

A second way to view these results is from the distributions of GAM (in 5 percentage point bands) by area or livelihood group, with the proportion of elevated U5MR cases in each band. This is shown in **figure 5A** by livelihood group. While the medians of the distributions are in the 5% to 15% range, in the upper tail of the skewed distributions there are many more elevated mortality cases for pastoralists—as well as many more with high GAM, and vice versa for agriculturalists. There are only 2 cases of GAM 20% to 25% for agriculturalists, versus 10 such cases for pastoralists. Thus a cutoff point of 20% yields virtually no cases for agriculturalists.

These contrasting distributions are more striking by area, as seen in **figure 5B**. This again shows clearly that cutoff points need to be established specifically by location, and applying a single cutoff point to diverse populations is unlikely to give consistent answers. For example, applying 20% GAM successfully identifies more than half of the elevated mortality cases in the Rift Valley Province and the Somali Region, but none in Oromia and SNNPR. Going to 10% picks up cases in Oromia and SNNPR, but applying this to the Rift Valley Province and the Somali Region, although obviously continuing to identify cases, does so at the cost of many false positives.

These results support the idea of using 15% to 20% cutoff points in largely pastoral regions—the Rift Valley Province and the Somali Region, as well as Sudan; and 5% to 10% in Oromia and SNNPR.

How unusual is a single survey result?

While a set of survey results can be interpreted with reference to mortality risk (as described above), the GAM estimate from a single survey can also be put in context by referring to the distribution of prevalences in the past, either for the area or for the livelihood group. The latter seems likely to be more useful and is addressed here. For this, the larger set of survey results is used (n = 897), not limited to those also having U5MR estimates.

The frequency distributions of GAM results vary considerably between groups, as indicated from the results shown in **figure 5** for those including mortality. Examples from Kenya and Ethiopia (Amhara, Oromia, SNNPR, and Tigray) for the full dataset are shown in **figure 6**. The very different pattern is clear, with Ethiopia (Amhara, Oromia, SNNPR, and Tigray) peaking at 5% to 10% and Kenya (Rift Valley) at 20% to 25%. Consider judging a new survey result. The GAM at which (say) 75% of results are lower than a new result is different by area—at about 13% in Ethiopia (Amhara, Oromia, SNNPR, and Tigray) and 25% in Kenya, for example. In other words, a result of 13% GAM is unusually high in Ethiopia (Amhara, Oromia, SNNPR, and Tigray), but not in the Rift Valley Province, where 25% GAM would be equivalently unusual. The cumulative distributions by area (which lead to this result) are shown in **figure 7**, and similar comparisons can be read off for other areas. Thus, for example, 50% of results would be less than 5% in Uganda, and 15% in Sudan; or, a Ugandan result of 15% would be very unusual (less than 5% of surveys have shown this), but common in Sudan (where more than 75% of survey results were above 15%); and so on.

The GAM cutoff points by area below which 75% of results would fall are given in **table 4**, ranging from 8% for Uganda to 25% for Kenya or Sudan. This means that a survey result of 8% GAM in Uganda is as unusual a result as 25% in Kenya (in comparison with the historical data, from geographic areas of concern in 2000–05). It implies that attention should be directed to areas with much *lower* prevalences in Uganda and mainly agricultural areas of Ethiopia, than in mainly pastoral areas of Kenya, Ethiopia, and elsewhere.

In the cumulative distributions by livelihood group (not shown), the pastoralists lie between Somalia and Ethiopia (Afar and Somali); the agropastoralists and agriculturalists are very similar to each other and lie

TABLE 3. Sensitivity and PPV of GAM in identifying elevated U5MR (> 2.0 and > 1.5), by livelihood group and geographic area

Variable	Of surveys with U5MR > 2.0				Of surveys with U5MR > 1.5				PPV at cutoff point, for U5MR > 2.0				% with U5MR > 2.0	Ratio PPV(1): U5MR	*N*
	GAM > to find 50%		GAM > to find 75%		GAM > to find 50%		GAM > to find 75%								
	Actual GAM	Rounded	Actual GAM	Rounded	Actual GAM	Rounded	Actual GAM	Rounded	Cutoff point: GAM (find 50%)	PPV (1)	Cutoff point: GAM (find 75%)	PPV (2)			
Livelihood															
Pastoral	19.0	20	13.8	15	17.9	17.5	11.5	12.5	20	0.63	15	0.56	32.7	1.93	104
Agropastoral	13.1	12.5	10.8	10	12.5	12.5	10.1	10	12.5	0.52	10	0.52	32.1	1.62	81
Agricultural	16.3	15	8.8	10	15.0	15	8.1	7.5	15	0.42	10	0.23	14.8	2.83	135
Area															
Rift Valley	22.1	22.5	20.4	20	21.9	22.5	20.1	20	22.5	0.70	20	0.72	48.5	1.44	33
Oromia	9.5	10	7.8	7.5	9.8	10	7.6	7.5	10	0.24	7.5	0.22	18.2	1.32	77
Somali	19.1	20	16.0	15	18.8	20	15.2	15	20	0.70	15	0.70	56.7	1.23	30
SNNPR	10.8	10	6.7	7.5	10.7	10	5.2	5	10	0.25	7.5	0.18	15.4	1.62	78
Sudan	22.9	22.5	18.8	20	20.5	20	17.0	17.5	22.5	0.50	20	0.35	26.7	1.87	45

GAM, global acute malnutrition; PPV, positive predictive value; U5MR, under-five mortality rate (deaths/10,000/day)

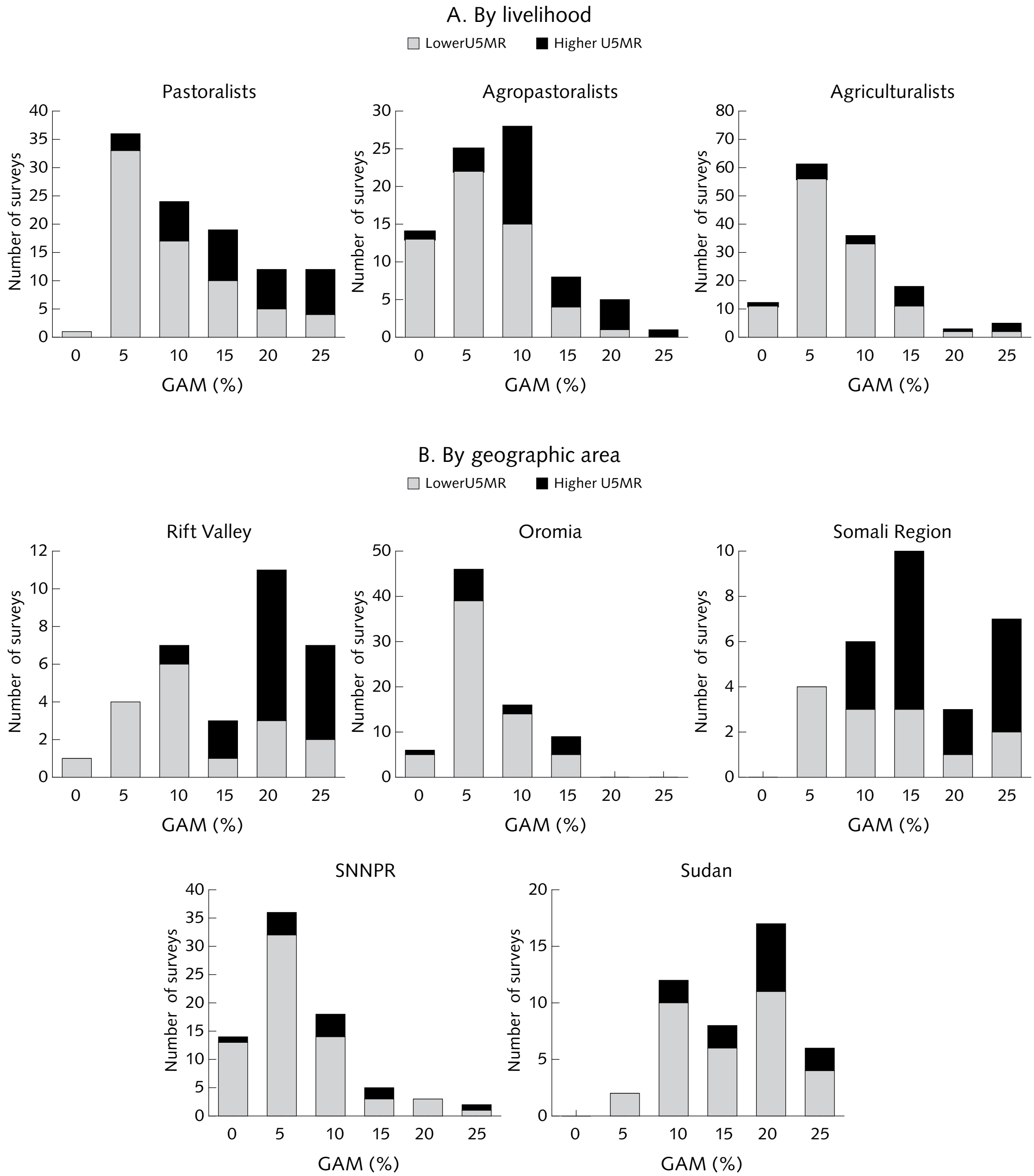

FIG. 5. Proportion of surveys defined by global acute malnutrition prevalence (GAM) band that had higher under-five mortality rate (U5MR) (>2.0/10,000/day) vs. lower U5MR

close to the Ethiopia (Amhara, Oromia, SNNPR, and Tigray) line.

Discussion

The common basis for judging relative needs for emergency intervention could be by comparing mortality risk, not anthropometry, across populations. Anthropometry, usually GAM, is more readily estimated and more commonly available than mortality. Analysis of historical associations between mortality and malnutrition, as reported here, allows calibration of GAM as a predictor of mortality risk. This differs substantially across different livelihoods and geographic areas. Different cutoff points of GAM are therefore appropriate

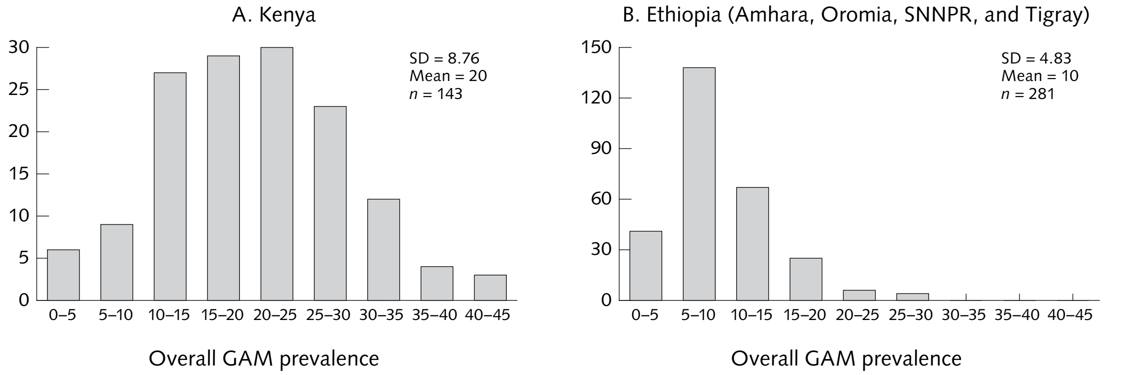

FIG. 6. Distribution of global acute malnutrition prevalence (GAM): Illustrations from surveys in (A) Kenya and (B) Ethiopia (Amhara, Oromia, SNNPR, and Tigray)

to estimate similar elevated mortality risks across these different populations and to indicate the need for intervention.

Wasting (GAM) and child mortality rates are higher for pastoralists and agropastoralists than for agriculturalists, both in times of food insecurity (usually drought-related) and otherwise. Children in agricultural areas have both lower GAM and lower mortality rates at given GAM prevalences.

The correlation between GAM and child mortality is considerably stronger for pastoralists and agropastoralists than for agriculturalists. GAM is therefore more effective in identifying groups with higher mortality risk for those practicing some pastoralism, but there is still useful predictive power for agricultural populations, with lower GAM cutoff points.

An effective way to display the data, allowing interpretation by inspection, is to plot each survey result in a time series—as shown in the upper charts (GAM) in **figure 2A–E**—by suitable geographic area, such as region or province. This provides context for interpreting new survey results as they come in. Graphic displays of GAM prevalences (and U5MR when available) like these are strongly recommended, and these alone would go some way to understanding normal and abnormal patterns, with implied cutoff points for intervention decisions, even without more formal analysis.

The cutoff point of GAM can be defined as that needed to classify groups so that a large proportion—say 75%—of high-mortality situations (e.g., U5MR > 2/10,000/day) would have been selected. This GAM cutoff point varies between 20% for the Rift Valley to 8% for Oromia or SNNPR, or from 15% for pastoralists to 10% for agriculturalists. Details for other groups are given in **table 3**. Using these cutoff points, examples of the positive predictive value—that is, the percentage of those cases above the GAM cutoff point with U5MR above 2/10,000/day—are as high as 72% for the Rift Valley or Somali Region and 56% for pastoralists, but only about 20% for agriculturalists or those living in

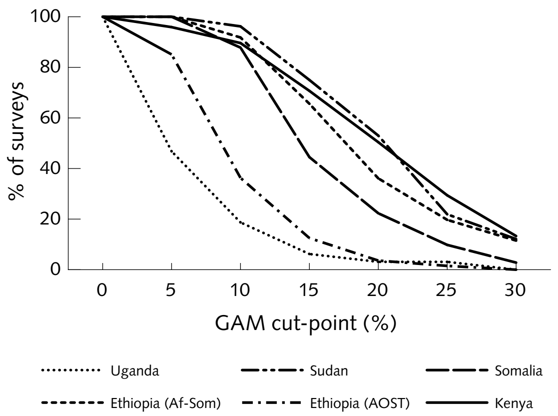

FIG. 7. How unusual is a single survey result? Percentage of surveys by area that gave global acute malnutrition prevalence (GAM) shown or higher. Example: if survey result gives GAM of 15% in Ethiopia (Amhara, Oromia, SNNPR, and Tigray [AOST]) or Uganda, this is higher than 80% to 90% of surveys compiled for 2000–05; but in Ethiopia (Afar and Somali [Af-Som]), Kenya, or Sudan, at least 70% of surveys gave GAM of 15% or more

TABLE 4. How unusual is a single survey result? Cutoff point (rounded) at which 75% of GAM results are below, 25% above, from surveys compiled for 2000–05

Variable	GAM (%)
Geographic area	
Uganda	8
Ethiopia (Amhara, Oromia, SNNPR, and Tigray)	13
Somalia	20
Ethiopia (Afar and Somali)	23
Kenya	25
Sudan	25
Livelihood	
Agricultural	15
Agropastoral	15
Pastoral	23

GAM, global acute malnutrition

predominantly agricultural areas (because the association is weaker for agriculturalists).

In sum, different cutoff points are indicated for different populations (see **table 3**). Conservatively, a wasting prevalence cutoff point of 15% seems appropriate for pastoral groups (equivalent to the present interpretation of the WHO emergency level) and 10% for agricultural livelihood groups. These may be further tailored if resources are scarce, and related to area. Thus for example a cutoff point of 20% in the Rift Valley Province (Kenya) and Sudan would be equivalent (in risk identification) to 15% in the Somali Region (Ethiopia) and to 7.5% in Oromia and SNNPR.

New survey results in an unknown situation could be assessed in several ways. First, they could be classified as above or below a wasting prevalence defined as having historically correctly identified (say) 75% of high child mortality cases (e.g., > 2 deaths/10,000/day), as discussed above. Second, single survey results of wasting prevalences can also be judged by comparison with the distributions of previous GAM prevalences alone (see **fig. 6**). Thus, for example, a prevalence above 8% is as unusual in Uganda as a prevalence above 25% in the areas of Kenya (mainly the Rift Valley) or Somali and Afar in Ethiopia.

The child mortality guidelines to define emergencies, e.g., of 2/10,000/day (see Background) may be appropriately invariant across populations. This directs attention to the pastoral and agropastoral groups, where child mortality is frequently higher than in other groups. This difference can also be seen by area, for example, in the Rift Valley Province of Kenya and the Somali Region of Ethiopia compared with Oromia in the time sequence plots in **figure 2C–E**. From this point of view, these populations need attention even in nonemergency conditions.

In contrast, however, there is also a danger that mortality risk in the agricultural population is underestimated by using too high GAM cutoff points. Applying even the usual 15% GAM cutoff point to agriculturalists may underestimate their risk. There will be more false positives for agriculturalists with the use of GAM, so additional assessments will be important—but this is relatively easier for these less remote populations.

Finally, the levels and trends in wasting and child mortality can contribute to classifying future crises. For example, it is probably overstating the case to describe situations with more than 30% wasting as "famine/humanitarian catastrophe," in view of the persistent estimates of these levels in areas such as the Rift Valley and Somali between 2000 and 2005, as in the FSAU "Phase classification" [3]. Now that the picture can be seen from laying out the trends as in **figure 2**; descriptions can refer to how commonly or rarely such events occur and relate to "what happened the last time" this situation was seen. This in no sense minimizes the gravity of the effects on populations—mortality rates regularly reach undoubted emergency levels of 4 or even 5 child deaths/10,000/day—but can facilitate interpretation in context.

These data provide a basis for re-examining the currently used guidelines (e.g., WHO [4]) for interpreting wasting prevalences. For the first time (in the literature found), this interpretation can be based on relation to risk—here of child mortality. Moreover, it seems no longer justifiable to apply a single wasting prevalence cutoff point when making decisions on emergency interventions for different populations, defined by area or by livelihood.

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The contribution of Child Health Days to improving coverage of periodic interventions in six African countries

Nicholas P. Oliphant, John B. Mason, Tanya Doherty, Mickey Chopra, Pamela Mann, Mark Tomlinson, Duduzile Nsibande, Saba Mebrahtu

Abstract

Background. *Child Health Days have been implemented since the early 2000s in a number of sub-Saharan African countries with support from UNICEF and other development partners with the aim to reduce child morbidity and mortality.*

Objective. *To estimate the effect of Child Health Days on preventive public health intervention coverage, and possible trade-offs of Child Health Days with facility-based health systems coverage, in sub-Saharan Africa.*

Methods. *Data were assembled and analyzed from population-based sample surveys and administrative records and from local government sources, from six countries. Field observations (published elsewhere) provided context.*

Results. *Child Health Days contributed to improving measles immunization coverage by about 10 percentage points and, importantly, provided an opportunity for a second dose. Child Health Days achieved high coverage of vitamin A supplementation and deworming, and improved access to insecticide-treated nets. Reported measles cases declined to near zero by 2003–5—a result of the combined efforts of routine immunizations and supplementary immunization activities, often integrated with Child Health Days. Collectively these activities were successful in reaching and sustaining a high enough proportion of the child population to achieve herd immunity and prevent measles transmission.*

Conclusions. *Additional efforts and resources are needed to continue pushing coverage up, particularly for measles immunization, in rural/hard-to-reach areas, amongst younger children, and less educated/poorer groups. In countries with low routine immunization coverage, Child Health Days are still needed.*

Key words: Child Health Days, deworming, immunization, insecticide-treated bednets, measles, vitamin A supplementation

Introduction

The 1978 *Declaration of Alma Ata* at the International Conference on Primary Health Care sought to bring essential health services to all people, and address the underlying social, political, and economic determinants of health [1]. However, support for implementing comprehensive Primary Health Care (PHC) on the part of political leaders and development agencies was limited [2, 3]. The drive towards PHC was replaced by a less comprehensive strategy (Selective Primary Health Care, SPHC), which focused on technical, medical interventions to address priority infectious diseases [4]. Since the early 1980s aspects of SPHC have included growth monitoring and promotion, oral rehydration therapy, breastfeeding and immunizations (GOBI) [5] and expanded programme on immunization (EPI) and EPI plus vitamin A supplementation and deworming (EPI Plus) [5], and Integrated management of childhood Illness (IMCI) [6].

Some potentially important interventions can be delivered periodically (once or twice yearly) through 'Child Health Days' (CHDs), notably childhood immunization, distribution of vitamin A supplements (in high doses), administration of deworming medication,

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and provision of insecticide treated bednets. The CHDs strategy, studied in this paper as implemented in six African countries, may be seen as a selective primary health care intervention. One issue considered is whether CHDs contribute to realizing the still-valid aims of primary health care as conceived 30 years ago.

CHDs have been implemented by governments in a number of sub-Saharan African countries with support from UNICEF and other development partners since the early 2000s. The strategy at the time of this study (2006-7) was known as "Regular Events to Advance Child Health" (REACH), but his term has since been changed to cover a broader set of activities.* The aim of CHDs is to reduce child morbidity and mortality, in line with the Millennium Development Goals [7].

An evaluation of the CHDs strategy in six sub-Saharan African countries (Ethiopia, Madagascar, Tanzania, Uganda, Zambia, and Zimbabwe) was undertaken on behalf of the Ministries of Health in those countries and the UNICEF Eastern and Southern Africa Regional Office (ESARO). The results given here—as part of the broader evaluation reported through UNICEF**—focus on quantitative estimates of CHD coverage, and possible spin-off effects on the coverage of routine (facility-based) coverage. Inferences, from these results and field observations [8]—given in more detail in the full report—concerning the interactions of CHDs with broader health services and community-based programs, and the related trade-offs, are discussed as implications for future programs.

What are CHDs?

Although the program design varies by country, generally CHDs take a vertical approach to health service delivery in the form of campaign-style events—drawing from the social mobilization and health package delivery strategies of child immunization campaigns and EPI Plus—and use existing health sector personnel and infrastructure with financial and technical support from development partners. The semiannual (6-monthly) events deliver a package of public health interventions tailored to the epidemiological profiles of national and/or sub-national areas and typically target children under 5 years of age. Health facilities, temporary outreach posts, and mobile units are used to deliver the package of interventions and extend coverage to hard-to-reach areas and ones generally underserved by the health system. The interventions are primarily preventive in nature and include two or more of the following: vitamin A supplementation, childhood immunization (notably for measles), deworming, and insecticide-treated bednets. These interventions have in common a likely effectiveness with periodic administration, usually every 6 months. See **table 1** for the content of the packages in the six countries studied here. The typical procedures for delivery of the interventions follow.

Measles immunization

Childhood immunization is incorporated in routine health services, and recommended schedules for children are established by the World Health Organization (WHO) [9]. Up to the mid-1980's most child immunizations were delivered in this way, with coverage typically around 40% in Sub-Saharan Africa [10]. International initiatives beginning in the 1980s pushed coverage into the 60% to 70% range for most antigens by the end of the 1990s, but this coverage then flattened out [11]. Since coverage was still inadequate, periodic campaigns were introduced (e.g. National Immunization Days [NIDs] and Supplementary Immunization Activities [SIAs]) which began to include other interventions, notably distribution of high-dose vitamin A supplements.

For measles immunization in particular—bearing in mind that near 90% coverage is considered necessary for herd immunity*** [12, 13]—the additional actions taken included:

- SIA catch-up campaigns—targeting children 9 months to 15 years of age (whether or not previously immunized) every 4 years, most recently as joint campaigns with CHDs;
- SIA follow-up campaigns—targeting children 6 or 9 to 59 months of age (whether or not previously immunized) with a periodicity depending on the success of the catch-up campaign and levels of routine coverage achieved, most recently with CHDs;
- Reaching Every District (RED), which is an outreach program aimed at improving routine coverage through health facilities, targeting districts with lowest coverage with additional resources;
- Child Health Days (CHDs)—typically targeting children 6 to 59 months of age with a package of interventions, including measles immunization and a mix of other antigens that varies by country; they

* The programmes assessed here are known as Child Health Days, Child Health Weeks, or Maternal and Child Health Weeks. Collectively, these were previously referred to as Regular Events to Advance Child Health (REACH)—an integrated package of child health interventions using existing primary health care infrastructure.

** UNICEF to publish. Multi-country evaluation of Child Health Days (CHDs) or Regular Events to Advance Child Health (REACH) in the Eastern and Southern Africa Region (ESAR).

*** Given that the measles vaccine is often only 85% effective with a single dose at 9 months of age, coverage above 90% may be needed to achieve herd immunity.

TABLE 1. Packages and delivery strategies by country, with timing of initiation

	Periodic—Child Health Days/Weeks (countries)	Routine services (all countries)
Package content	» VAS (all countries) » Deworming (Eth, Mad, Tan, Uga, Zam) » Measles (all countries) » ITN's (Eth, Tan) » Supplementary feeding (Eth) » Growth monitoring (Eth, Tan, Uga)	» DPT 1-3 ; (6-14 wks) » OPV 1-3 (0-14 wks) » BCG (birth on) » TT2 (in pregnancy) » Measles (9 mos – ?) » Growth monitoring
Delivery strategy	» SIAs (all countries) » EOS (Eth) » EEOS (Eth) » CHDs (Tan,Uga, Zim) » CHMs (Mad) » CHWs (Mad, Zam) » SSME (Mad)	» RED (Eth, Tan, Uga, Zim) » Revitalization (Uga)

Timeline of introduction of CHD interventions

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006
Ethiopia			SIA (+ VAS)		SIA	RED →	EOS →		
Madagascar	VAS 1/yr →			Child Health Months →		CHWks →	SIA		SSME →
Tanzania			SIAs	CHDs →	RED →				
Uganda		Revit →		SIA		SIA	CHDs →		SIA
Zambia			CHDs →			SIA →			
Zimbabwe					SIA RED →		CHDs →		

CHDs, Child Health Days (Tanzania, Uganda, Zimbabwe); CHMs, Child Health Months; CHWs, Child Health Weeks (Madagascar, Zambia); BCG, bacille Calmette-Guérin vaccine; DPT 1-3, 3 doses of diphtheria-pertussis-tetanus vaccine; EEOS, Expanded Enhanced Outreach Strategy (Ethiopia); EOS, Enhanced Outreach Strategy (Ethiopia); ITNs, insecticide-treated bednets; OPV 1-3, 3 doses of poliovirus vaccine live oral; RED, Reach Every District, targeted support for routine immunization; Revit, revitalization of routine immunization services (Uganda); SIA, supplementary immunization activities (measles follow-up, 9–60 months, or catch-up, 9 months–15 years); SSME, Maternal and Child Health Weeks (Madagascar); TT2, tetanus toxoid (2 doses to pregnant women), VAS, vitamin A supplementation

are conducted semiannually, often together with previously scheduled SIAs.

Vitamin A Supplementation

Since the late 1980s high doses of vitamin A have been administered to children 6 months and older (100,000 IUs for children 6 to 11 months of age and 200,000 IUs for children 12–59 months) as part of disease management, especially for measles and diarrhea [13]. Research has indicated a reduction in case-fatality from this protocol [14–18]. Widespread distribution of high dose vitamin A supplements for prevention began in Africa with EPI Plus, integrating VAS with child immunization, mainly through routine immunization supported by EPI. As child immunization campaigns—notably polio National Immunization Days, NIDS and later SIAs—gathered momentum, so vitamin A supplementation went along with these. As CHDs developed, VAS became a regular part of them.

Administration of vitamin A supplementation prior to EPI Plus, NIDs/SIAs, and CHDs was primarily for treatment (in contrast to immunization), and estimates of vitamin A supplementation coverage from Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) only began with the mass distribution of vitamin A supplements for prevention. Estimates of coverage prior to the preventive distribution were not available, but coverage would probably have been low on a population basis.

Deworming

Administration of deworming medications (usually albendazole or mebendazole), while familiar in schools, was limited for preschool children largely to treatment of in- and out-patients prior to CHDs. It was not previously a regular part of EPI Plus or child immunization campaigns, but is included in most of the programmes evaluated here.

Insecticide-treated bednets

Distribution of insecticide-treated bednets, usually two per household with pregnant women, lactating women, or children under 5 years of age, through public and private mechanisms has been ongoing since late 1990s. Distribution of insecticide-treated bednets through CHDs began in 2004. Preprogram coverage is not known except through survey data (usually DHS) which indicate low levels of household possession and use on a population basis. Estimates of insecticide-treated bednet coverage require careful interpretation as they may not necessarily reflect endemic areas targeted by programs, and surveys do not typically occur during the rainy season or periods when the use of insecticide-treated bednets would be most expected [15].

Methods

Data

The evaluation procedures, including qualitative assessments, involved a desk review of relevant program and policy documents and scientific literature, and, through field visits during November 2006 and March 2007, key informant interviews with managers and staff at all levels of the health system and caregivers or beneficiaries.

Two types of coverage data were compiled: from administrative (program) sources, and from population-based sample surveys, in line with WHO practices [16]. For each country, the Ministry of Health or UNICEF country office provided administrative coverage estimates from WHO/UNICEF Joint Reporting Forms (JRFs) or summary sheets for measles immunization, vitamin A supplementation reporting forms for vitamin A supplementation, and campaign reports (e.g. CHDs, SIAs, NIDs). UNICEF country offices also provided coverage estimates from population-based sample surveys. Coverage estimates were provided from the series of population-based sample surveys. Demographic and Health Surveys were provided by ORC Macro or Measure. WHO and UNICEF provided joint estimates based on triangulation of administrative coverage reported to them by the Ministry of Health and population-based sample surveys. Additional population data were obtained from the United Nations [17], and government statistical offices. Data on coverage is summarized in **table 2** and detailed in the following figures (reference numbers for sources are in brackets): **figure 1** [sources: 18–21], **figure 2** [22], **figure 3** [23–38], **figure 5** [34–36], (also data from UNICEF vitamin A supplementation reporting forms, Ministry of Health], **figure 6** (UNICEF vitamin A supplementation reporting forms, Ministry of Health] **figure 7** [30–42], and **figure 8** [Ministry of Health].

Trends in reported measles cases were available for each country (as reported by the Ministries of Health to WHO, see **fig. 4** [39]) between 1990 and 2005–06, providing baseline and follow-up data points. Baseline and follow-up data for vitamin A deficiency, VAD—as serum retinol and/or night blindness—were available only from population-based sample surveys for Ethiopia and Zambia, and only for select subnational areas in the former [40–44]. Data on the health impact of deworming through CHDs was only available for Uganda, as weight gain [45]; however, this outcome has since been questioned [46]. No data on the health impact of insecticide-treated bednets that could be related to CHDs was available. Additional background data on child morbidity and mortality were obtained from the WHO Global Database and the WHO Mortality Database [47].

Analysis of coverage trends

Coverage trends were estimated separately from administrative data (e.g., routine immunizations, SIAs, and CHDs as reported by Ministries of Health or UNICEF) and population-based sample surveys—primarily DHS—using Microsoft Excel 2003. To ensure comparability within each coverage trend, care was taken to match levels of aggregation (e.g., national or subnational areas), age-bands and, where possible, timing of data collection. Missing data for a given year were estimated by linear interpolation between known data values.

Coverage of measles immunization, vitamin A supplementation, de-worming, and insecticide-treated

TABLE 2. Coverage Estimates

		Ethiopia	Madagascar	Tanzania	Uganda	Zambia	Zimbabwe
Measles Immunization	S	54% (96) *27% (00)* 52% (01) 35% (05) 54% (06)	44% (99) *55% (00)* 59% (03)	81% (96) *78% (99)* 80% (04)	60% (96) 53% (99) *57% (00)* 71% (05) 68% (06)	87% (96) *84% (02)*	88% (97) 79% (99) 66% (05)
	R-P	SIA 15% (01) SIA 23% (04) **CHD 46% (06)**		SIA 49% (00) **CHD 97% (05)**	*54% (00)* **72% (03)** **75% (05)**	**CHD 15% (02)** **CHD 103% (03)**	**CHD 93% (06)**
	R-T	34% (96) *37% (00)* SIA 74% (01) 56% (04) SIA 90% (04) 47% (06) **CHD 91% (06)**	56% (98) 81% (00) *57% (01)** 61% (02) 98% (04) 84% (05)	78% (96) *78% (00)* SIA 93% (00) 97% (03) 91% (05) **CHD 99% (05)**	*61% (00)* **83% (03)** **86% (05)** **(note—CHDs included)**	93% (96) *85% (00)* **CHD 110% (02)** **CHD 108% (03)** 79% (05)	73% (97) 68% (01) 85% (05) **CHD 95% (06)**
Vitamin A Supplementation	S	*60% (00)* 22% (04) 46% (05)	*24% (00)* 76% (03)	*13% (99)* 46% (04)	*38% (01)* 69% (06)	28% (97) 53% (98) *67% (02)*	94% (06)
	R-P	**CHD 12% (04)** **CHD 83% (06)**		**CHD 80% (01)** **CHD 81% (05)**			
	R-T	88% (99) *16% (01)* 62% (03) **CHD 93% (04)** **CHD 91% (06)**	94% (99) *38% (00)* **CHD 88% (03)** **CHD 99% (06)**	*22% (00)* **CHD 80% (01)** **CHD 95% (05)**	*37% (01)* 81% (02) **CHD 59% (04)** **CHD 70% (05)**	*75% (99)* **CHD 71% (00)** **CHD 92% (02)** **CHD 79% (06)**	*78% (02)* 20% (04) **CHD 37% (05)** **CHD 91% (06)**
Deworming	R-T **All CHD**	40–90% (05–06)	80–100% (04–06)	80–90% (04–05)	30–120%, by region	20–80% by region (04)	Not done
Insecticide-treated bednets	S	Hhd possess bed net 6% (05); ITN 3% (05); U5s slept under ITN last night 2% (05)	Not done	Hhd possess bed net 46% (04); ITN 23% (04); U5s slept under ITN last night 16% (04)	Hhd possess bed net 34% (06); ITN 16% (06); U5s slept under ITN last night 10% (06)	Hhd possess bed net 27% (06); ITN 44% (06); U5s slept under ITN last night 23% (06)	Not done

CHD, Child Health Day; DHS, Demographic and Health Survey; ITN, insecticide-treated bednet; REACH, Regular Events to Advance Child Health; SIA, supplementary immunization activities; U5s, children under 5 years of age.

a. Results selected stress differences—full results and sources in other tables or figures except insecticide-treated bednets [30, 37, 25, 40]. S: survey results—data for selected years before and after REACH/CHD started, where available. R-P: routine administrative data—per population total, after REACH/CHD started. R-T: routine administrative data—per target area population after REACH/CHD started. Years in parentheses; /1 or /2 refers to first or second round in the year. Data selected to try to show before REACH levels, then highest, lowest, and latest coverage estimates. Bolded entries are from CHD administrative data. Italicized entries are ± 1 year from start of CHD or similar biannual outreach program. Bednet refers to a bednet not treated with insecticide.

* Refers to an average of three values, 2000–02, of 81%, 29%, and 61%.

bednets were estimated from both administrative data and sample survey estimates (except deworming, data for which were not available from surveys). For measles immunization and vitamin A supplementation, three types of coverage estimates are shown:

» Survey estimates: from DHS, MICS or other population-based surveys (e.g., questions 457, 458 and 450G from Ethiopia 2000 DHS [28]); here the denominator is the sample size, taken to be representative (and weighted);
» Reported estimates from administrative data (for routine immunization services, SIAs, CHDs, etc.), using the denominator from the same source; the concerns here are first, that the population estimates for the target area may be outdated, and second, that the estimates refer only to the target areas, and not to the total target population in the country or region; hence, this is an estimate of "target area population coverage" (R-T);
» Reported estimates as above, but using census estimates of the overall target population in the country, not just in the targeted area (this applies particularly to SIAs); this gives the estimate for the coverage of all children in the country (of the relevant age range, usually 6 to 59 months)—referred to as "total population coverage" (R-P).

Where possible, the contribution of CHDs to changes in coverage was estimated by triangulating program and survey data, considering baseline and follow-up estimates, as well as the timing of other programs.

Reported program coverage versus survey estimates

This analysis showed differences between reported coverage (i.e., from administrative data reported by the Ministry of Health or UNICEF) and population-based estimates from DHS. Reported coverage for child measles immunization and vitamin A supplementation is often much greater than DHS estimates, and for measles immunization this is usually well beyond the 95% confidence intervals of the DHS estimates (DHS typically does not report standard errors for vitamin A supplementation). This has been observed elsewhere for DPT3 (three doses of vaccine against diphtheria, pertussis, and tetanus). Studies by Murray and collaborators [48, 49] have shown that officially reported DPT3 immunization coverage from national data in 45 countries was higher (about 16 percentage points for crude coverage and 20 percentage points for valid coverage*) than estimates from nationally representative DHS [52]. Additionally, the size of the difference increased as officially reported coverage increased; trends in officially reported coverage were only weakly correlated with trends in survey estimates, and recall bias was not indicated in the survey data [53]. These findings are relevant to interpretation of data considered, particularly for reported coverage.

In this study, reported routine measles immunization coverage is compared with DHS estimates of coverage by 12 months of age. Routine measles immunization programs usually attempt to provide measles immunization following the WHO recommended schedule (at 9 months). The DHS estimate of coverage by 12 months of age approximates the WHO recommended schedule and is therefore comparable with routine measles data. The difference between reported routine measles coverage and DHS estimates by 12 months observed in this study may be due to erroneous denominators or numerators used to calculate routine coverage (the problem is usually with denominators), sampling and nonsampling error in survey data (the former could not be evaluated), and finally children may be getting vaccinated at older ages (over 12 months of age).

DHS estimates of measles coverage among children 12–23 months of age at any time prior to the survey are compared with reported coverage for routine immunization, SIAs and CHDs. This second indicator should pick up most of the coverage achieved through routine services as well as coverage through SIAs, CHDs, and joint SIA/CHD campaigns despite the wider age bands of SIAs and CHDs—unless children are not being immunized until after 23 months of age. The differences between SIA coverage, CHDs coverage and DHS estimates may also be due to the practice of reporting SIA and CHD coverage for target-area populations rather than the total target population. When program coverage was weighted by total age-band populations from census projections rather than targeted areas, it showed greater comparability with levels and trends estimated through population-based sample surveys.

Limitations of data available

Administrative or program reports of numbers participating in CHDs may cover a broader age range (e.g., above five years, referred to as "crude coverage") than those estimated in surveys, and contributing to the higher coverage estimates. Moreover, this numerator estimate may not be compared with the same age range in the denominator, which can be lower if the target group is restricted, as is common practice, to children under 5 years of age. This can also contribute to over-estimates of coverage from administrative data. Underreporting in terms of failure of some districts to report routine data was noted as only a minor problem during field visits (and if they did so fail, the intended population may not have been included in the denominator anyway). Thus the tendency is likely to be for routine administrative

* Crude coverage refers to coverage regardless of adherence to the schedule recommended by WHO and presence of documentation (e.g., vaccination marked on the Road to Health Card); valid coverage refers to coverage of children adhering to the schedule recommended by WHO and documented by a health card.

data to over- rather than under-estimate coverage.

In some cases target population (denominator) estimates were calculated for these analyses from census data, using certain assumptions because official projections for target populations (e.g., children 9 to 59 months or 9 months to 15 years of age) were not always available.

A limitation of the DHS estimate for measles immunization coverage among children 12 to 23 months at any time prior to the survey is that although it picks up immunization documented on child health cards as well as undocumented vaccination (e.g., from caregivers' recall), it does not consider whether children were vaccinated following the WHO-recommended schedule. This is particularly important when DHS estimates are compared with routine coverage (which attempt to follow the WHO schedule), but less important when comparing DHS estimates with SIAs and CHDs because children are vaccinated in these campaigns regardless of their vaccination history. The DHS estimates used are from the cohort who were 12 to 23 months of age during the previous year, when they should have been vaccinated [9]. Thus, this estimate is more restricted than, and not necessarily comparable with, the routine coverage estimate.

Recall bias from sample surveys was not evaluated here; the literature is not conclusive on the accuracy of caregivers' recall of vaccinations, with some studies indicating high accuracy [50–52] and others low accuracy [53–55].

Estimations of under-5 measles deaths were not attempted; however, trends in under-5 measles deaths were assumed to follow the trends in reported measles cases—an assumption supported by Otten et al. [56, 57].

Results

Interpretation of coverage data

Data on coverage were obtained from three main sources (as discussed in Methods): from national household sample surveys (such as DHS) in which questions on receipt of services were included ('S' in column 2 of **table 2**); from routine administrative reports of the program implementation, when the denominator is the estimated numbers of eligible children in the *target* population ('R-T' in **table 2**); and, usually based on the same original routine data, estimates of the *national child population* coverage as made by WHO/UNICEF, where the denominator is the nationally eligible population ('R-P' in **table 2**). The population coverage was recalculated from the reported target group coverage using national census data when feasible.

The coverage related to the target group (R-T) estimates how far the program reaches the intended population, and the coverage in relation to the national population (R-P) estimates its overall potential effect. The coverage of the target population (R-T) should be greater than the national population coverage (R-P). The survey-derived results (S) are calculated for national coverage estimates. The total population coverage and the survey estimates are intended to measure the same parameter.

As indicated in the Introduction, other results [52, 53] from a number of countries have shown that sample survey derived coverage estimates are consistently lower than those from routine reports, in line with what is generally found here. Although surveys probably give a more realistic estimate, they may also contain bias downwards due to faulty recall. This is gone into further in the Discussion section. For the present purposes, *trends* in coverage in relation to the timing of starting semiannual CHDs are important, and these can be assessed from both routine and survey data. However, actual coverage *levels* are also crucial, especially for immunization to preempt disease outbreaks, and for these the inconsistency between data sources is more pronounced.

Evolution of CHDs

CHDs were held twice per year, for periods ranging from 2–3 days (Tanzania) to 1 week (Ethiopia), 6 months apart (usually in June and December). The interventions included in the "package" are listed in **table 1** (second column).

Measles immunization had been provided routinely through the health services for many years. With concern for maintaining high levels of coverage, immunization was periodically extended with SIAs, as indicated in the lower part of **table 1**, starting between 2000 and 2002, depending on the country. In Ethiopia, Tanzania and Zimbabwe, another program referred to as "Reach Every District" (RED), provided targeted support for immunization through health services in underserved areas. Follow-up immunization was included in CHDs, and in some cases (e.g., Uganda and Zambia) additional SIAs were continued as well to try to drive immunization coverage up further.

In interpreting the coverage data in **table 2** (and later figures), the timing of starting these programs—CHDs, SIAs, REDs—needs to be taken into account, as the apparent trend in coverage through time provides the primary basis for assessing effects of the CHDs. In **table 2**, the data were selected from the longer time series available to try to show the levels before programs started, the peak of coverage achieved, and the most recent estimate.

Measles immunization

The changes in measles immunization coverage rates, estimated from surveys (**table 2**, top section) range from 27 percentage points (from 27% to 54%) in Ethiopia, 11 percentage points (from 57% to 68%) in Uganda, 4 percentage points (from 55% to 59%) in Madagascar, and 2 percentage points (from 78% to 80%) in Tanzania. These changes estimate the total percentage of children immunized by any route or program and aim to estimate changes from just before CHDs started.

Ethiopia has the lowest coverage, in terms both of proportion of the child population targeted and of coverage within the targeted group. Nonetheless, both of these factors increased after the initiation of CHDs (Enhanced Outreach Strategy [EOS] in Ethiopia) to 46% of the population and 91% of the target group covered in 2006 (**table 2**). During this time, the coverage through routine attendance at clinics also increased somewhat (e.g., to 56% of target population) in 2004. In this case the estimated 46% population coverage of CHD in 2006 is not far from the survey estimate (of coverage by all routes) of 54%. Although the contribution of different routes cannot be disentangled from these data, it seems likely that CHDs increased overall coverage, but a very substantial percentage of the child population remains unimmunized.

In Uganda, measles immunization coverage was estimated from surveys to be steady at around 60% in the latter 1990s, similar to the value from the routine report for 2000 (see **fig. 1**). The "revitalization" program, which put additional resources into the routine services, started in 1999, linked to the RED program [58]. According to routine data, by 2002 target group coverage had risen to 77%. CHDs started in 2004, and reported target group coverage rose to nearly 90% and population coverage (not shown in **fig. 1**) to 75%. Sample survey results estimated population coverage at 70%. Although these figures cannot be fully reconciled, they do suggest substantial improvements, but still with a significant portion of the population—perhaps 25% to 30% of the child population—not immunized.

Tanzania, Uganda, Zambia, and probably Zimbabwe have results fairly similar to each other. CHDs produced high coverage, with nearly all the population targeted, so that estimates are similar by total child population or by target population (**table 2**). The routine coverage through clinic attendance remained high. For Uganda, CHD coverage is reported with clinic attendance, estimated as reaching about 85% of the target population, 75% nationally. Tanzania and Zambia are estimated from reports to be approaching 100% coverage. However, survey data show less coverage, around 80% in Tanzania and Zambia, and less still in Uganda. With high coverage now being reported, the difference from survey results becomes more significant—if uncovered percentages are considered, these may be 15% to 30% from surveys or 0% to 15% from reports. This may be compared with the target put forward by WHO/UNICEF [10]. The conclusions here are that CHDs had increased overall coverage, but the differences between survey estimates and reports are significant for programming and policy decisions.

Success in covering underserved regions was assessed from trends in numbers of regions with low (< 50%), medium (50% to 80%) and high (> 80%) immunization rates, as shown in **figure 2** for Ethiopia, as an example. The Ethiopia RED program [59], starting in 2002-03 contributed to reducing the number of least-served regions from more than 70% to 40%, a process continued by EOS. Nonetheless, these results also stress the urgent need for wide increases in coverage, as the risk of measles outbreaks is high at these levels.

A summary for the survey-derived coverage estimates for all six countries is given in **figure 3**. Overall, the upward coverage trend after around 2000 suggests

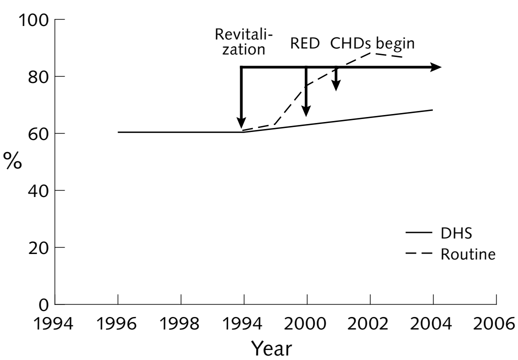

FIG. 1. Trends in measles immunization coverage in Uganda. DHS (Demographic and Health Survey): children 12 to 23 months of age at any time prior to survey by card or mother's recall. Routine: routine measles immunization among children under 12 months of age as reported to WHO/UNICEF. CHDs, Child Health Days; RED, Reaching Every District

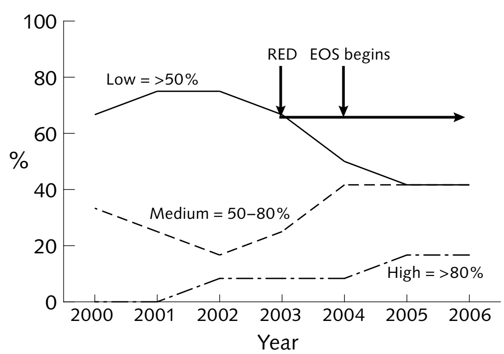

FIG. 2. Trends in the percentage of regions in Ethiopia within categories of routine measles coverage for children under 1 year of age. Measles immunization campaigns besides EOS (Enhanced Outreach Strategy): National Immunization Days in 2000, 2001, 2002; Measles Plus in 2004). RED, Reaching Every District

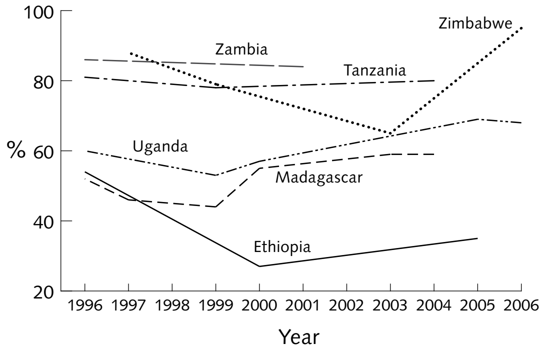

FIG. 3. Measles coverage trends according to survey data for children 12 to 23 months of age, inclusive of postinfantile immunizations, by card or mother's recall.

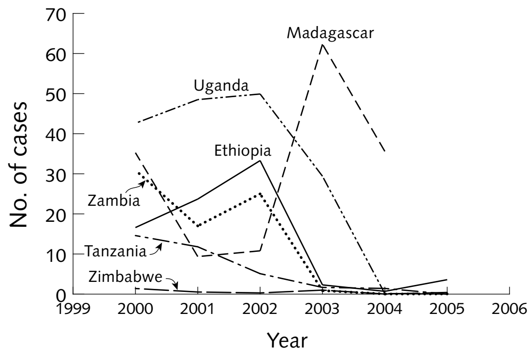

FIG. 4. Trends in measles cases per year. The number of cases per 1,000 is given except for Ethiopia, for which the number of cases per 100 is given

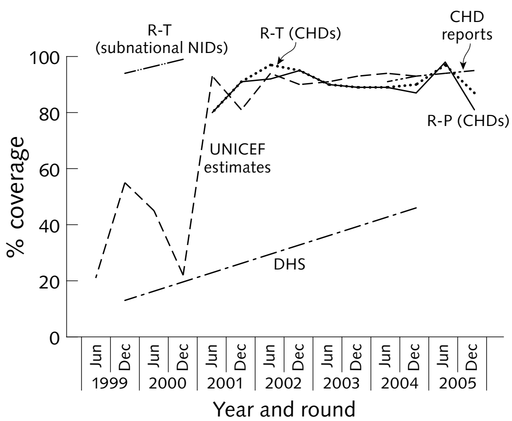

FIG. 5. Vitamin A supplementation coverage in Tanzania among children 6 to 59 months of age

S is coverage for mainland Tanzania by card or mother's recall from published reports. Sources: Ministry of Health (Tanzania), Tanzania Food and Nutrition Centre (National Immunization Days [NIDs] and Supplementary Immunization Activities); UNICEF (UNICEF Vitamin A Supplementation Reporting Form; Demographic and Health Surveys (DHS 1999 and 2005). CHD, Child Health Days; NIDs, National Immunization Days; R-P (total population coverage); R-T (target area population coverage)

an impact on coverage of CHDs, together with SIAs and REDs. However, by this measure, none of the six countries studied, except perhaps Zimbabwe, have yet exceeded a measles immunization coverage rate of 90%.

Direct effects of CHDs on measles immunization coverage and measles morbidity/mortality, separate from those of SIAs and RED, cannot be estimated from the available data. However, triangulation of data on measles immunization coverage and reported measles cases among children under five [43] suggests a plausible positive effect of CHDs, in conjunction with SIAs and routine services, on child measles cases in all countries. Such results, shown in **figure 4** for the six countries studied here, are likely to be the main contributor to the reported 91% reduction in measles deaths in Africa from 2000-2006 [60]. These outcomes are likely attributable to joint SIA/CHDs, stand-alone CHDs, and improved routine immunization coverage.

Vitamin A supplementation

Before the mass distribution of vitamin A supplements through campaigns, survey results (**table 2** second row) show low coverage of vitamin A supplementation, such as 13% (Tanzania, 1999), 28% (Zambia, 1997), and 38% (Uganda, 2001). Coverage was increased through SIAs held once every 2 to 4 years and then was maintained semiannually through CHDs (sometimes held jointly with scheduled SIAs). This was shown by subsequent survey data—coverage increased to 50% to 80%, and as high as 94% in Zimbabwe (2006). Ethiopia appears different; however, the 2000 survey was at the same time as an SIA which included vitamin A supplement distribution.

Administrative reports from CHDs supported these estimates (**table 2**, second row, lower part) as usual giving somewhat higher values when they can be estimated as population coverage estimates (Ethiopia and Tanzania) compared to surveys. Here again the differences between coverage of the national child population (R-P) and the coverage of the target population (R-T) reflects whether the CHDs were planned to be national in coverage.

Thus, CHDs improved vitamin A supplementation coverage about 30 percentage points above what was achieved prior to their initiation, from survey results. This estimate would be about 50 percentage points from routine reports (e.g., Madagascar, Tanzania, and Zambia). Whereas SIAs increased this coverage once every 2 to 4 years, CHDs achieved this on a semiannual (6-monthly) basis. This confirms the effectiveness of semiannual CHDs in achieving and maintaining high coverage of periodic high-dose vitamin A supplementation.

Progress can be illustrated from the more extensive data available from Tanzania, as shown in **figures 5**

and 6. In 1999 and 2000, the two rounds of distribution promoted through clinics and SIAs achieved an average of 35% coverage. This was stepped up to a sustained (reported) 80% to 100% through CHDs beginning in 2001. Nonetheless, DHS survey reports only gave estimates of an increase from 13% in 1999 to 46% in 2004—a similar proportional increase, perhaps, but still suggesting that actual coverage is lower than reported. Viewed in terms of distribution between regions (**fig. 6**), the changed vitamin A supplementation procedures show that the benefits were spread among all regions: for example (from reports, not surveys), from only 20% of regions having greater than 80% coverage in 2000 to 100% in 2006.

The survey estimates of coverage of vitamin A supplementation are summarized in **figure 7**. The general upward trend corresponds to the gathering momentum of CHDs. The results indicate a typical increase of about 30 percentage points in vitamin A supplementation coverage associated with CHDs.

The impact of CHDs on vitamin A deficiency could be estimated only in Ethiopia and Zambia, because the other countries lacked either baseline or follow-up data. These showed substantial declines in the prevalence of low serum retinol (from 66% in 1997 to 54% in 2003 among children 6 to 59 months of age in Zambia) [44, 45], and night blindness (from 4.0% in 1996 to 0.8% in 2005 among children 6 to 59 months of age in select regions of Ethiopia* [46, 47]).

Deworming

Mass distribution of deworming medication began around 2004 as part of CHDs. The coverage achieved was similar to that for other parts of the CHDs package, especially VAS, which is also similar in intended periodicity (every 6 months). On average, at least 80% of the target area populations were covered, according to administrative data, after the first (start-up) round. **Figure 8** shows a summary of deworming coverage estimates from CHD program data for two rounds per year for 2004-06. Coverage of the total population was lower when the whole country was not targeted (not shown). Geographical differences were also seen, in line with differential coverage of CHDs, ranging, for example, from 30% to 120%** by region in Uganda and 25% to 80% by province in Zambia (not shown).

Insecticide-treated bednets

Distribution of insecticide treated bednets and re-treatment of bed nets through CHDs began in 2004-05, in

* For comparison, the Sub-Saharan Africa trends were estimated as 41.4% in 1995 to 40.8% in 2000 for low serum retinol, and 1.5% night blindness in both 1995 and 2000 [48].

** Percentages greater than 100% are likely due to inaccurate (i.e., underestimated) denominators.

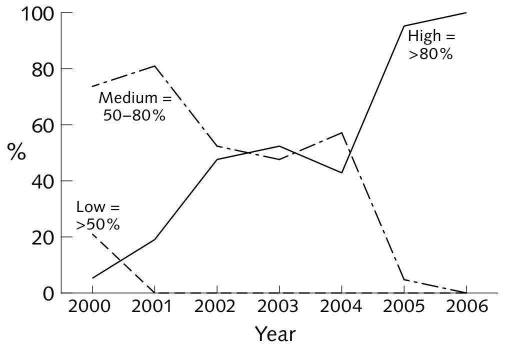

FIG. 6. Trends in the percentage of regions within categories of Child Health Day vitamin A supplementation coverage among children under 5 years of age, 1999–2006. Source: Ministries of Health (Tanzania)

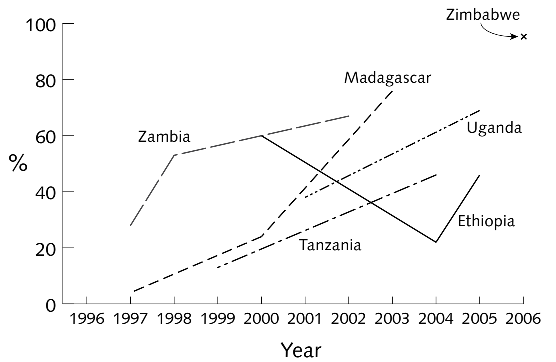

FIG. 7. Vitamin A coverage among children from surveys. Coverage is for children 6 to 59 months of age except for Ethiopia 2004, for which coverage is for children 6 to 72 months. Coverage is for the 6 months prior to survey according to mother's recall or card

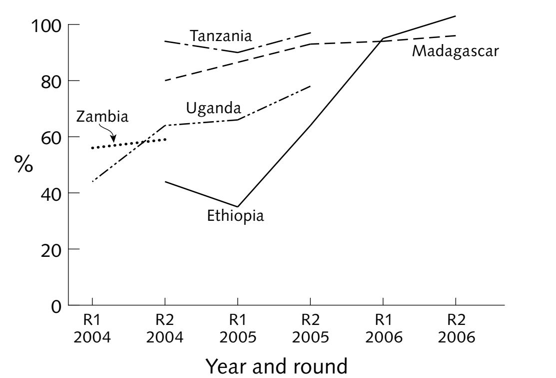

FIG. 8. Deworming coverage among children 12 to 59 months of age from Child Health Days program data. Source: Ministries of Health

Ethiopia, Tanzania, Uganda and Zambia. Estimates of household possession and use among children under-five are from survey data (DHS). Data are summarized in **table 2**, fourth section.

The cumulative number of insecticide-treated bednets delivered in Ethiopia by 2006 through CHDs was 6.6 million according to administrative data, equivalent to about 50% of the under-five population; however not all Ethiopians live in endemic areas. Because programs typically target distribution of insecticide-treated bednets to endemic areas, coverage is expected to be higher in these areas compared to non-endemic ones [20]. In Tanzania in 2004, the rate of household possession of at least one insecticide-treated bednet was 23%, and the percentage of under-fives sleeping under an insecticide-treated bednet in the previous night was 16%; in Uganda these percentages were 16% and 10%, respectively in 2006; and in Zambia they were 44% and 23%, respectively in 2006. Although trends in the possession and utilization of insecticide-treated bednets were not available from survey data because questionnaires changed between 2000 and 2006, administrative data from CHDs indicate some contribution toward improvement in access to insecticide-treated bednets, if not utilization, over the period. CHDs appear to be an effective way of distributing insecticide-treated bednets (or retreating them), although this early in the program, and with a lack of survey data, interpretation must be limited.

Discussion

Effects of CHDs

CHDs contributed to improving measles immunization coverage by about 10 percentage points; they maintained vitamin A supplementation coverage comparable to levels achieved through NIDs but did so semiannually rather than once every 2 to 4 years; they achieved high coverage of deworming, which had not been widely administered on a population basis prior to CHDs; and they contributed to improvements in access to insecticide-treated bednets. Collectively, these were very useful improvements, if not a revolution. Intervention coverage increased more in countries and subnational regions which started at lower levels of coverage, suggesting improved equity. Additional efforts and resources are needed to keep pushing coverage up, particularly for measles immunization, in rural or hard-to-reach areas, amongst younger children, and in less educated or poorer groups.

Differences between estimates from surveys and routine administrative data

Levels of measles immunization coverage and vitamin A supplementation coverage estimated from administrative data (from Ministries of Health or UNICEF) were higher than comparable population-based sample survey estimates from DHS. This has been observed elsewhere for DPT3 [52, 53].

Measles immunization coverage estimates here, from reports of SIAs and CHDs were assessed as up to 20 percentage points higher than comparable estimates from survey data; the largest differences were in Ethiopia and Madagascar (**table 2**). Routine measles immunization coverage from facilities (among children < 12 months of age) was up to 40 percentage points higher according to estimates from administrative reports than the comparable indicator from DHS (immunization by 12 months of age among children 12–23 months of age). Vitamin A supplementation coverage was also higher by 5 to 50 percentage points between CHD estimates than it was from comparable survey data; again, the largest differences were in Ethiopia and Madagascar (**table 2**).

These differences are probably due, first, to incorrect estimates of the target population (i.e., denominators) for administrative data. Second, when CHDs are implemented stepwise, Ministries of Health usually report target area coverage (R-T in **table 2**: the numerator is children of a given age-band who receive the intervention from the geographic area targeted; and the denominator is an estimate of the population of this age-band in the area targeted). However, survey estimates are given as total population coverage (comparable with R-P), and thus are expected to be lower when there is area targeting.

Likely health and nutrition impacts

In all countries studied except Madagascar, reported measles cases dropped almost to zero by 2003–05. This implies that immunization coverage must have been high enough in preceding years to have a major effect, as this low a level had not been observed previously, indeed WHO and UNICEF issued celebratory press releases on the basis of their results [64]. It seems clear that the combination of routine immunizations and supplementary immunization activities, recently often integrated with CHDs, were successful in reaching a high enough proportion of the child population to achieve herd immunity and prevent transmission. Conventionally this is taken as 83%–95% coverage [9, 60]. In any event, even if the coverage is not well determined, it may be that it reached a critical level. The next few years—if immunization rates are maintained or improved—will tell whether this is so, if there are no more measles outbreaks.

Despite the paucity of outcome data, positive impacts from vitamin A supplementation were considered plausible in most countries based on coverage and known efficacy. Perhaps ironically, vitamin A supplementation in Africa may be less important when measles immunization is effective, as much of the morbidity associated with vitamin A deficiency used to be related to measles. Nonetheless vitamin A is understood to have extensive impacts on the immune system and other defenses against disease [14–18, 61–66] and there is little doubt that substantial benefit is to be had from reducing vitamin A deficiency. Whether this is effectively achieved by periodic vitamin A supplementation is open to some doubt, however [62, 63].

Periodic deworming is well established as an effective method for control of soil-transmitted helminthes [64]. The effectiveness is correlated with coverage. In preschool children the benefits are reported to include improved motor and language development, and reduced malnutrition, notably anemia. These factors have not been evaluated in relation to the CHDs studied but are likely to have benefitted.

A positive impact from distribution, treatment and re-treatment of insecticide-treated bednets is also plausible based on coverage and known efficacy [65, 66]. Additional investigations of the quality and use of insecticide-treated bednets in practice would be important before drawing conclusions about likely effects on malaria transmission.

Integration of CHDs with routine PHC systems

CHDs were often run as largely self-contained campaigns. In Uganda, Zambia, and Zimbabwe—countries in our sample with more developed health systems—integration with the routine system was greater. There are some advantages of running separate events, particularly for improving and maintaining immunization coverage. Moreover, there is some question as to whether integration of vertical programs with routine programs does indeed deliver the advantages it would seem to promise [67–69]. This seems especially the case in resource-poor settings where there is a risk in a highly integrated system that resources may be spread so thinly across the different service-delivery activities, such as supervision, logistics and training, that they fail to reach intensity adequate to achieve impact on health. On the other hand, an earlier review of tropical disease programs found that effective programs decentralize and integrate operations but retain a central policy-making authority [68].

Program and policy implications

Improving child health, nutrition, and survival, in Africa as in other poor regions, requires addressing a mix of needs including but not confined to food security, health, and caring capacity—in line with the widely-agreed UNICEF framework [69]. Recent recommendations [70] focus upon increasing the coverage of key child health interventions such as breastfeeding, complementary feeding, micronutrient supplementation, etc. The process for extensive coverage of interventions such as these can be based on the concepts of primary health care, as put forward at Alma Ata [1]. Recent specifications of how to set about this (e.g., from [71]) might combine primary care [72], IMCI [73], community-based health and nutrition programs [74], and vertical interventions for vaccine-preventable diseases [75], malaria [74], and helminth infections [73].

One issue here is how far vertical actions (e.g., CHDs) can support local ones. Helping to build an effective health system, with community- and facility-based components, should be a broader objective to which CHDs can contribute, rather than compete with. It is important to avoid repeating earlier missteps that have inhibited the achievement of broad-based primary health care, and these missteps crucially include favoring delivery of narrow interventions over wider development of local capacity.

CHDs should be organized and implemented in ways that build local capacity rather than create dependency, and foster synergies rather than opportunity costs. Suitable combinations and resulting synergies depend on the level of development of service infrastructure, capacity, and resource availability. Funds for health are a major constraint, especially in Africa; on average around $20 per capita per year (public plus private) [76–78], in poorer areas much less. Perhaps the highest priority for using health resources is immunization. Then, the priority for the next level of resources (some of which are also used by CHDs) should be used to build up a mix of community- and facility-based programs. These can and should address the most common diseases, and the capacity of the system should be built and sustained to address changing needs and be flexible in delivering cost-effective interventions (e.g., defined as dollars per disability-adjusted life-year [DALY] saved [77]).

Balanced resource allocations in different conditions

What are the trade-offs between the different approaches—semiannual regular events like CHDs, and continuous community- and local facility-based primary care? And hence what does this imply for future resource allocations, in different settings (e.g., defined by health system resources and nutrition and disease patterns)? In countries where routine measles immunization coverage is low, the only *essential* activity is the SIA, every four years or so, since this is the only intervention without which major disease outbreaks may occur. Otherwise variations in intervention coverage (be it for measles, VAS, deworming etc.) would not have catastrophic effects, and one could afford to build coverage more slowly. Moreover SIAs for measles every 4 years would require fewer resources.

Thus an alternative that could be considered is infrequent SIAs for measles, and covering other needs by building up the health system. Whether or not to do this clearly depends not only on the current effectiveness of the health system, but how readily resources *not* used for CHDs could build them up. In relatively well-served areas, and where there are already effective community-based programs the balance may shift away from CHDs. Only a very limited number of important health and nutrition interventions are effective at six month intervals, and thus there is a limit to the impact that CHDs can, by their intermittent nature, achieve. The trade-offs therefore include the potential opportunity cost of possibly withdrawing resources from interventions (the majority) that cannot be undertaken at six-month intervals—for example all the rest of IMCI interventions.

The opportunity costs of CHDs, especially use of staff time in planning, meetings, etc., are substantial. Staff are pulled away from their routine service delivery tasks for CHDs. An issue arises as to whether this time would be better spent on other activities, including training and supervising village health workers. This is an important consideration as the scarcity of health personnel, particularly in Africa, affects not only CHDs but also routine services.

In sum, the main trade-off would seem to be whether to continue to use resources for CHDs (including SIAs every few years as needed), or to do SIAs only, as self-contained exercises, and use the resources saved (not just funds but personnel time) to develop community programs with community health workers, supported and supervised by health staff (currently used for CHDs), and to strengthen facility-based programs. A sequence could be to shift the balance gradually towards strengthening routine health care with increasing integration with CHDs and support for community-based programs. This will require more sense of ownership of CHDs by a wider range and number of health workers, supervisors and managers.

What might be added to CHDs?

Given that CHDs achieve high coverage, this raises the idea that other activities suitable for six-month intervals may be introduced with lower costs than if they were self-standing. Examples from existing routine activities include health and nutrition education and counseling; promotion of and fostering contact with other services, such as antenatal care and reproductive health services; and possibly activities linked to prevention and management of HIV/AIDS and tuberculosis.

One important new opportunity may be with iodine deficiency, where this persists, since oral supplementation (with iodized oil) is one of the few other interventions ideal for 6-monthly use. Iodine deficiency during pregnancy is very damaging to the fetus, causing irreversible brain damage. Two or three decades ago administration of iodized oil was commonly used to prevent iodine deficiency, and the studies then showed it to be effective on a population basis when given orally every 6-12 months, and suitable for use during pregnancy [78]. This was supplanted by iodized salt, which remains usually the intervention of choice. However, success of CHDs in getting to remote areas—which was not possible when intermittent iodized oil supplementation was last common—coupled with critical difficulties in ensuring access to iodized salt in hard-to-reach areas, particularly in Ethiopia, may have changed this equation.

Administration of fluoride as an varnish to teeth among children has been shown to be efficacious in preventing oral caries, and studies have shown it to be effective on a population basis at intervals in countries with high caries rates, inadequate fluoride availability and underdeveloped dental health systems [79–81]. Morbidity related to oral caries is a major cause of hospitalization even in some developed countries (e.g., Canada) [80, 81]. Where conditions are appropriate, administering fluoride varnish may be an opportunity for CHDs.

Future evaluation research

Evaluating the trade-offs between semiannual CHDs-type approaches and community- and local facility-based programs requires more data than available for the present study, particularly on relative costs. One recommendation is that such a comparative cost-effectiveness calculation should be done. Two specific questions could be posed are along the following lines:

» How much of the burden of disease is averted by the 6-monthly CHD activities, compared with use of these resources in building up community- and facility-based programs, which would address a wider range of diseases and malnutrition?

» What additional interventions can be delivered through CHDs? In this context, what periodicity for CHDs becomes impractical—shorter periodicity eventually merges into mobile clinics visiting every few weeks—and what are the trade-offs there?

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The impact of orphanhood on food security in the high-HIV context of Blantyre, Malawi

Jonathan Rivers, John B. Mason, Donald Diego Rose, Thomas P. Eisele, Stuart Gillespie, Mary Mahy, and Roeland Monasch

Abstract

Background. *A 2004 UNICEF/UNAIDS/USAID survey in Blantyre, Malawi, examined methods to improve monitoring and evaluation of interventions aimed at orphans and vulnerable children.*

Objective. *A derivative of this larger study, the present study utilized the household data collected to assess differences in food security status among orphan households with the aim of helping food security programmers focus resources on the households most affected.*

Methods. *Orphan households were classified by number and type of orphans supported. Descriptive analyses and logistic regressions were performed to assess differential vulnerability to food insecurity according to these classifications.*

Results. *Multiple-orphan households and multiple-orphan households that cared for at least one foster child were 2.42 and 6.87 times more likely to be food insecure, respectively, than nonorphan households. No other category of orphan household was at elevated risk.*

Conclusions. *The food security impact of caring for orphans varied significantly among orphan households, requiring food security planners to focus resources on the households most heavily impacted by HIV/AIDS, including multiple-orphan households, rather than focusing on conventional designations of vulnerability, such as orphans and vulnerable children.*

Key words: Food security, HIV, Malawi, orphans

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Introduction

In Malawi, it was estimated in 2004 (around the time of this study) that 14% of prime-age adults were living with HIV and close to 50% of households in vulnerable communities cared for at least one orphan [1]. As the epidemic intensified, concerns over the impacts of HIV/AIDS on household livelihoods and food security status increased. HIV, often contracted early in adulthood, sickens and kills a disproportionate number of young adults, who are often caretakers or wage earners. This cripples household livelihoods, leaves numerous children orphaned, and forces communities to cope with both lost productivity and increased dependency in the form of vulnerable, and commonly HIV-positive, orphans.

Many studies from throughout Africa have documented the impact of AIDS mortality and orphanhood on livelihoods and household well-being. In Uganda, AIDS mortality has reshaped households, increased dependency ratios, and in many cases forced either the very young or the very old to assume primary responsibility for the well-being of the household [2–4]. As caretakers and wage earners become ill and die, uninfected household members are forced to adopt new roles and responsibilities, which often results in lost income and compromised productivity. In Tanzania, for instance, older teenage boys and women in households with terminally ill male adults had to work 6 to 7 hours more per week on farming. Adult men, in these same households, needed to spend 6 hours more per week working on household chores. Upon the death of the ill male, Tanzanian households report both a decline in total nonfarm income and a temporary shift in types of crops produced, away from higher-value crops [5]. Other studies show similar findings. In Mozambique and Kenya, studies have shown a decline in either the share of household income (Mozambique) or the total income (Kenya) obtained from nonfarm or wage labor activities when confronted with an adult death [6, 7]. In Uganda, studies indicated that households affected by an adult death were more likely to be headed by a female, suffer reduced sales of milk, have lower total and diversified income, and shift toward less labor-intensive livelihood activities [8, 9]. Shifting labor patterns, coupled with decreased crop production, have also been documented in studies in Kenya, Rwanda, and Zambia [10–12]. Finally, in South Africa, research has shown adult death to be associated with a 40% to 50% decrease in household income [13].

Given the household impacts of AIDS deaths and orphan care, it has long been recognized that orphan households need support. To provide effective and well-targeted support, however, food security planners must recognize the complexity of orphan households and the diverse set of challenges and vulnerabilities they face. Understanding which orphan households are particularly vulnerable to lost livelihoods, poverty and food insecurity is more important now than ever, as the community burden of AIDS is straining established foster networks and forcing more and more orphans into nontraditional fostering situations, such as elderly- or child-headed households. To date, the differing levels of vulnerability in orphan households are not well understood, particularly in regard to a household's ability to access food. This study assesses differing vulnerability to food insecurity among certain subsets of orphan households, defined by both the type and number of orphans cared for and the fostering situation of the orphan. Given that many HIV-affected children are fostered prior to their parent's death, when their parent(s) are too sick to provide for them, this study also assesses the independent food security impacts of fostering (either of orphaned or nonorphaned children), with a particular emphasis on the combined effects of caring for orphans and foster children. Understanding how these factors impact food security in the high-HIV context of Blantyre may contribute to designing effective interventions for vulnerable orphan households in other areas heavily affected by the virus.

Methods

Study sample

Data were available from a 2004 United Nations Children's Fund (UNICEF), Joint United Nations Programme on HIV/AIDS (UNAIDS) and US Agency for International Development (USAID) survey of households in Blantyre, Malawi, collected in a larger effort of assessment and monitoring of interventions directed toward orphans and vulnerable children. Blantyre was chosen as the study location because it is both the largest urban center and the main industrial and commercial capital of Malawi. Since it is the economic center of the country, movements of people and goods, and the informal economies that arise in support of this, have made Blantyre, like other important commercial centers in Southern Africa, a major epicenter of the AIDS epidemic. Sentinel surveillance data from Blantyre estimated that by 2003, close to 30% of adults 15 to 49 years of age were living with HIV [14].

The survey used a cluster-based design to obtain a representative sample of households from Blantyre. The survey collected household-level information on demographics, socioeconomic conditions, fostering status, and food security status, as well as child-level information on orphan status. The final analytic sample consisted of 276 households and 769 children. Additional details on sample design and survey implementation have been published previously [15].

Household food insecurity status

The household questionnaire contained a food security module drawn from the tradition of using qualitative, experiential-based questions originally developed in the United States in the 1990s [16–20], and more recently adapted to developing-country contexts [21–24]. The module consisted of eight questions concerning consumption behaviors (e.g., cutting the size of meals) employed to cope with a lack of resources in the previous 30 days. All questions had a yes/no answer format and were asked of the household respondent. The first three questions were asked of everyone. To minimize respondent burden, the fourth question, concerning whether the respondent went a whole day without eating, was asked only if the respondent answered affirmatively to one of the previous three. The final four questions address child consumption behaviors and were asked of all households with children. The full food security module is shown in **table 1**. Households were classified as food insecure if they answered at least one of the first three questions affirmatively, as well as question 4 or 8 affirmatively. All other households were considered food secure.

While similar questionnaires are now utilized in a variety of developing-country contexts, tests of reliability were conducted to ensure its effectiveness in this particular context. Food insecurity status was linearly related to household wealth status, which is illustrated in **figure 1**. Moreover, the Kuder-Richardson alpha for the entire eight-question scale was 0.84, indicating strong internal consistency within the questionnaire.

Orphan and foster classifications

A child was classified as an orphan if one or both parents were not alive at the time of data collection. Thus, orphan status was determined using two questions in which the respondent was asked, "Is [child's name] natural mother alive?" or "Is [child's name] natural father alive?" Several variables were created based on responses to this question. First, households were

TABLE 1. UNICEF/UNAIDS/USAID food security instrument used in Blantyre, Malawi[a]

Questions in food security module	% of households answering "yes"
1. In the last 30 days did you ever cut the size of your meals or skip meals because there was not enough food or money to buy food?	47.9
2. In the last 30 days did you ever eat less than you felt you should because there was not enough food or money to buy food?	49.9
3. In the last 30 days were you very hungry but did not eat because there was not enough food or money to buy food?	38.4
Check 1, 2, and 3. If at least one "yes" response go to 4.	
4. In the last 30 days did you ever not eat for the whole day because there was not enough food or money to buy food?	22.7
If at least one child age 0–17 living in the household go to 5.	
5. In the last 30 days did you ever cut the size of your child(ren)'s meals because there was not enough food or money to buy food?	60.7
6. In the last 30 days did the child(ren) living in your household ever skip meals because there was not enough food or money to buy food?	45.1
7. In the last 30 days was/were the child(ren) living in your household ever hungry but there was not enough food or money to buy food?	51.9
8. In the last 30 days did the child(ren) living in your household ever not eat for a whole day because there was not enough food or money to buy food?	26.9

a. A household was classified as food insecure if it answered at least one of the first three questions AND question 4 affirmatively OR if it answered question 8 affirmatively.

simply classified by whether there was an orphan residing in the household or not, resulting in a dichotomous variable coded as "orphan" or "nonorphan." Second, a variable was created to classify households by the type of orphan(s) residing within them. This variable was coded as follows: "one maternal orphan," "one paternal orphan," "one double orphan," "more than one orphan of the same orphan type," or "more than one orphan of different orphan types." Third, orphan households were classified as to the number of orphans, resulting in a final orphan variable coded as "no orphans," "one orphan," or "two or more orphans."

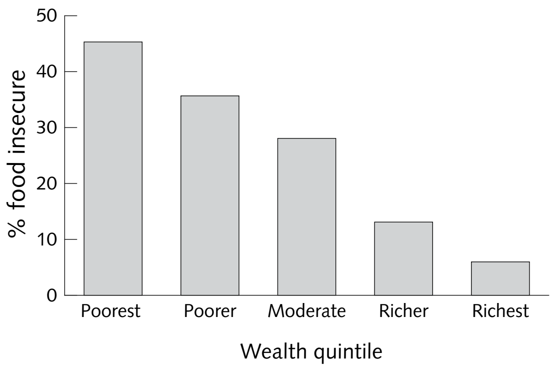

FIG. 1. Percentage of food-insecure households examined by wealth quintile in Blantyre, Malawi

Last, households were classified by their foster status. This classification, determined by each child's "relationship to head of household" and "relationship to primary caregiver," was conducted in two ways, and in both cases households were determined to be either "foster" or "in situ." In the first classification method, an orphan household was classified as a "household with in situ orphan(s)" or a "household with foster orphan(s)." In this case, "household with in situ orphan(s)" refers to a household where a surviving parent was either the head of the household or the primary caregiver for all orphans in the household or, in the case of double orphans, where the eldest sibling was listed as both the head of the household and the primary caregiver for all orphaned children in the household. A "household with foster orphan(s)," on the other hand, refers to a household where the household head and primary caregiver of at least one of the orphans was not the surviving parent, but instead was either an aunt, uncle, grandparent, other relative, or an unrelated person. In the second classification method, the fostering status of all children—*orphaned or not*—was assessed in all households *whether they cared for an orphan or not*. In this case, a household was classified as either an "in situ household" or a "foster household." The specific classifications were carried out in the same manner as discussed above, with "in situ household" referring to a household where a parent was listed as either the head of the household or the primary caregiver for all children residing in the household, and "foster household" referring to a household where the household head or primary caregiver was not a parent of at least one of the children—*orphaned or not*—residing in the household.

Classifying household fostering status in these ways allowed researchers to assess related, yet quite different, questions. By classifying orphan households by orphan fostering status, it was possible to assess the food security impact of a household fostering an extended family member or an unrelated child versus the impact seen when one or both parents die and the children remain in the same household, being cared for by the surviving parent or eldest sibling. Understanding which household type is more vulnerable is important as both have potentially difficult burdens to overcome. Households that foster an extended family member or a child from an unrelated family may find themselves overburdened by the additional mouths to feed or, in the case of grandparent headed households, the head of the household may be too old to adequately provide for the children. Orphan households headed by single parents or children have lost at least one caretaker or breadwinner, which can compromise the surviving parent's ability to properly feed and care for the children. In high-HIV areas, these households are often further destabilized by the remaining parents becoming sick with HIV-related illness.

Finally, classifying the foster status of all households (whether they care for orphans or not) allows the independent effects of fostering on food security status to be examined. It also allows the combined impact of fostering and caring for orphans to be examined. In a high-HIV context, understanding the impact of fostering, even if the child is not orphaned, is important, since children of HIV-positive parents are often sent to live with members of their extended family or unrelated families even before their parents succumb to the virus, usually because the parents become too sick to care for them properly. Understanding the combined food security impact of caring for foster children (whether orphaned or not) and orphans is potentially even more important, as households in areas heavily impacted by AIDS are likely to care for HIV-affected orphaned and nonorphaned foster children, even as these households cope with adult illness and death themselves.

Analysis

Both bivariate and multivariate analyses were conducted. Bivariate analysis consisted of cross tabulations examining associations between household food security status, the various orphanhood and fostering classifications, and other household characteristics (such as wealth status of the household and number of household members), using chi-square tests to measure the significance of differences at $p < .05$. Multivariate analysis using logistic regression was employed to test whether associations observed in bivariate comparisons between various orphanhood and fostering characteristics persisted when potential confounding variables were taken into account, including wealth status and household size. Interaction terms were included where necessary.

A wealth index for each household was derived from a principal components analysis (PCA) using the following variables: toilet type, flooring material, access to electricity, and ownership of a bed, television set, radio, motorcycle, and car. The wealth index was constructed in the conventional manner, with the first principal component selected as the index. Then households were ranked by this index and categorized into quintiles. All analyses were conducted in STATA 9.0. Analyses were weighted by a household weight variable.

Results

Sample population

In total, 276 households from Blantyre, Malawi, were included in the final analysis. As **table 2** indicates, 36.9% of households cared for at least one orphan. When examined by number, 20.7% of households cared for only one orphan and 16.2% cared for two or more. Among single-orphan households, caring for one paternal orphan was slightly more common than caring for either maternal or double orphans (8.3% vs. 5.6% and 6.9%, respectively), whereas the majority of multiple-orphan households had the same type of orphan, as opposed to a mix of different orphan types (11.5% vs. 4.7%).

When the foster situation of orphans was examined, at least one orphan was fostered in 62% of orphan households (or 23% of all households), whereas all orphans were in situ in 38% of orphan households (or 14% of all households). When the foster situation of all children (orphans and nonorphans) was examined, 56% of households were in situ households, while 44% were foster households.

Orphan households were slightly but nonsignificantly wealthier than nonorphan households. When disaggregated by the number of orphans, single-orphan households appeared wealthier than nonorphan households, while multiple-orphan households appeared to be poorer. However, the differences were again not statistically significant. When wealth by fostering status among orphan households was examined, neither households with foster orphans nor those with in situ orphans were significantly wealthier or poorer than nonorphan households. When wealth was examined by fostering status as defined for all children (orphaned or not), households with at least one foster child were

TABLE 2. Description of sample and bivariate comparisons

Household type	*N*	% of total sample	Household size	Wealth index	% food insecure
All households	276	—	5.3	0.000	25.6
Nonorphan households	174	63.1	4.9	−0.046	23.3
All orphan households	102	36.9	6.1[a]	0.088	28.4
Households with 1 maternal orphan	15	5.6	5.3	0.323	0
Households with 1 paternal orphan	23	8.3	5.2	0.313	21.7
Households with 1 double orphan	19	6.9	6.2	0.215	10.5
Multiple orphans of the same type	32	11.5	5.6	−0.339	50.0[a]
Multiple orphans of different types	13	4.7	9.3[a]	0.269	46.2
Households with 1 orphan	57	20.7	5.6	0.283	12.3
Households with > 1 orphan	45	16.2	6.7[a]	−0.162	48.9[a]
Households with in situ orphan(s)	39	14.2	5.2	−0.077	35.9
Households with fostered orphan(s)	63	22.7	6.6[a]	0.191	22.6
Households with 1 in situ orphan	14	5.3	4.7	0.648[a]	15.8
Households with 1 foster orphan	38	15.4	5.9[a]	0.156	11.3
Households with > 1 in situ orphan	22	8.8	5.5	−0.516[a]	49.8
Households with > 1 foster orphan	21	7.3	8.2[a]	0.264	48.0
In situ household	155	56.0	4.7	−0.107	26.3
Foster household	121	44.0	6.1[b]	0.140[b]	25.2

a. Significantly different from nonorphan households ($p < .05$).
b. Significantly different from households with in situ children ($p < .05$).

wealthier than households where all children lived with at least one of their parents.

Food security and orphanhood

As shown in **table 2**, 25.6% of all households reported being food insecure. Initial bivariate comparisons indicated a slightly higher prevalence of food insecurity among orphan (28.4%) than nonorphan (23.3%) households, although the differences were not significant ($p = .369$). When single-orphan households were assessed by type of orphan cared for (one maternal, one paternal, or one double orphan), bivariate comparisons indicated no significant difference in food security status. When disaggregated by number of orphans, however, multiple-orphan households (driven by multiple-orphan households with the same orphan types) were found to be significantly more food insecure than nonorphan households. Overall, 48.9% of households with two or more orphans were food insecure, versus only 12.3% and 23.3% of households with one or no orphans, respectively ($p = .002$). Differences in food security status between single-orphan and nonorphan households (with single-orphan households appearing less likely to be food insecure) were not significant ($p = .127$).

The results of multivariate logit models adjusted for both household size and wealth status (**table 3**) were consistent with bivariate comparisons, again indicating that the number of orphans cared for was more highly associated with food insecurity than the type of orphan cared for. Multiple-orphan households remained most vulnerable, being 2.42 times more likely to be food insecure than households with no orphans ($p = .03$). Within multiple-orphan households, adjusted odds ratios were similar (between 2 and 2.5) for households caring for the same versus multiple-orphan type(s); however, only households caring for same orphan type were at significantly higher risk for food insecurity than nonorphan households.

Food security and fostering status

After assessing the food security impact of caring for orphans, the next step was to assess how fostering children (whether orphaned or not) affected household food security status. As **tables 2** and **3** show, fostering a child, whether that child was orphaned or not, did not have any significant impact on household food security status, with foster households having a slightly but nonsignificantly lower prevalence of food insecurity than in situ households (25.2% vs. 26.3%).

When assessing the foster status of orphans only, bivariate comparisons suggested that households with in situ orphans appeared to have a substantially higher prevalence of food insecurity than households with at least one foster orphan (35.9% vs. 22.6%), but the prevalence among neither group in bivariate and multivariate comparisons (see **tables 2** and **3**) was significantly different from the prevalence among nonorphan households. Taking this a step further and disaggregating orphan households by the number of orphans cared for, bivariate comparisons (**table 2**) indicated that multiple-orphan, in situ households and

TABLE 3. Logistic regression results[a]

Variable	Unadjusted models			Adjusted models		
	Odds ratios	95% CI	*p*	Odds ratios	95% CI	*p*
Nonorphan	—	—	—	—	—	—
Orphan	1.31	0.73–2.34	.369	1.16	0.60–2.22	.661
Total household size	—	—	—	1.23	1.07–1.41	.003
Wealth index	—	—	—	0.37	0.24–0.56	< .000
Nonorphan	—	—	—	—	—	—
Households with 1 maternal orphan[b]	—	—	—	—	—	—
Households with 1 paternal orphan	0.94	0.27–3.24	.926	1.19	0.32–4.43	.799
Households with 1 double orphan	0.39	0.08–1.87	.242	0.33	0.06–1.79	.200
Multiple orphans of the same type	3.20	1.42–7.19	.005	2.47	1.01–6.01	.046
Multiple orphans of different types	3.04	0.87–10.67	.083	2.15	0.63–7.33	.223
Total household size	—	—	—	1.21	1.04–1.40	.015
Wealth index	—	—	—	0.38	0.25–0.59	< .000
Nonorphan	—	—	—	—	—	—
1 orphan	0.47	0.18–1.24	.127	0.47	0.17–1.43	.20
> 1 orphan	3.15	1.54–6.46	.002	2.42	1.09–5.36	.03
Total household size	—	—	—	1.19	1.03–1.38	.02
Wealth index	—	—	—	0.39	0.25–0.59	< .000
Nonorphan	—	—	—	—	—	—
Households with in situ orphan(s)	1.93	0.87–4.25	.105	1.80	0.75–4.33	.190
Households with foster orphan(s)	0.99	0.48–2.03	.976	0.81	0.37–177	.594
Total household size	—	—	—	1.26	1.09–1.44	.001
Wealth index	—	—	—	0.38	0.25–0.57	< .000
Nonorphan	—	—	—	—	—	—
Households with 1 in situ orphan	0.61	0.11–3.42	.577	1.13	0.16–7.75	.901
Households with 1 foster orphan	0.42	0.13–1.31	.135	0.38	0.12–1.23	.107
Households with > 1 in situ orphan	3.26	1.29–8.23	.013	2.17	0.78–6.04	.140
Households with > 1 foster orphan	3.03	1.14–8.04	.026	2.78	0.98–7.86	.054
Total household size	—	—	—	1.19	1.03–1.38	.017
Wealth index	—	—	—	0.37	0.24–0.59	< .000
In situ household	—	—	—	—	—	—
Foster household	0.94	0.53–1.66	.838	0.84	0.44–1.60	.587
Total household size	—	—	—	1.23	1.07–1.42	.004
Wealth index	—	—	—	0.38	0.26–0.58	< .000
Nonorphan	—	—	—	—	—	—
Household with 1 orphan	0.50	0.17–1.47	.207	1.47	0.19–11.31	.712
Household with 2 or more orphans	3.30	1.53–7.13	.002	0.93	0.26–3.39	.913
Foster household	0.87	0.44–1.71	.677	0.57	0.20–1.60	.286
Interaction 1 orphan household × foster household	—	—	—	0.39	0.03–4.61	.454
Interaction 2 or more orphan household × foster household	—	—	—	6.87	1.11–42.57	.038
Total household size	—	—	—	1.16	0.99–1.36	.068
Wealth index	—	—	—	0.37	0.24–0.57	< .000

a. The dependent variable is food insecurity (see Methods).
b. Predicts food security perfectly and thus is excluded from the models.

multiple-orphan households with at least one foster orphan both had a higher prevalence of food insecurity than nonorphan households. In the adjusted logit models, however, differences persisted only among multiple-orphan households with at least one foster orphan, with these households being 2.78 times more likely than nonorphan households to be food insecure (p = .054). The lack of significant difference seen among households with multiple in situ orphans in the adjusted logit model appeared driven by sample size, as the odds ratio (2.17) was similar in magnitude to the odds ratio seen among multiple-orphan households with at least one foster orphan.

The final step was to assess whether fostering any children (whether orphaned or not) modified the food security impact of caring for orphans. Here multivariate logit models indicated that the households that cared for multiple orphans and at the same time cared for a foster child (whether that child was one of the orphans or not) emerged as the group most vulnerable to food insecurity. The adjusted logit model indicated that these households were 6.87 times more likely to be food insecure than nonorphan households (p = .038). By contrast, no other combination of household caring for orphans or foster children had any elevated risk of food insecurity when compared with nonorphan households.

Discussion

With the AIDS epidemic creating a rising tide of orphans, food security concerns have focused on orphan households as a particularly vulnerable group in need of support. To aid food security planning, this study assessed the impacts of orphanhood and fostering on food security status. Household survey data from the heavily HIV-affected city of Blantyre, Malawi, were assessed. The extent of the epidemic in Blantyre was largely reflected in the findings of this study, with more than one-third of households caring for at least one orphan and almost 17% of households caring for multiple orphans.

The results of this study indicated that vulnerability to food insecurity, as expected, varied significantly among orphan and foster households and appeared to depend heavily on the level of HIV-affectedness. Multiple-orphan households, and particularly multiple-orphan households that cared for at least one foster child (orphaned or not), were found to be the only orphan households at significantly elevated risk for food insecurity. As these households are probably among the most heavily HIV-affected, these findings fit the expected pattern and suggest that HIV/AIDS may be impacting household livelihoods and food security status by degrading traditional fostering networks, forcing extended-family households and nontraditional foster homes (e.g., grandparent- or child-headed households) to care for children even when they do not have the resources.

Although the findings among multiple-orphan households may indicate a degradation of foster care networks in Blantyre, the findings among single-orphan and foster households may provide some evidence of their continued resilience. Here single-orphan and foster households were not more food insecure than nonorphan households and in fact, to the contrary, appeared slightly better off (albeit nonsignificantly). This may indicate that, at least among households least affected by HIV/AIDS, foster care networks still function effectively and remain a viable safety net for orphaned children.

In conclusion, the findings of this study suggest that the food security impact of caring for orphans varied significantly even among orphan households. Thus, rather than focusing on conventional designations of vulnerable households such as "orphan households," food security planners should focus resources on households that are either most affected by HIV/AIDS (as evidenced by the number of orphan or foster care children cared for) or those that are experiencing significant degradation of established foster care systems.

Limitations

This study had certain limitations. First, causes of adult illness and death were not documented in the survey. Therefore, it was impossible to differentiate between children orphaned or fostered because of AIDS and children orphaned or fostered due to other causes. As AIDS-related illness and deaths may be a larger burden on the household than illness or death due to other causes, this limitation may have obscured the true food security impact of caring for AIDS orphans or foster children. The extent of this problem, however, is probably mitigated by fact that HIV/AIDS remains one of the most important causes of morbidity and mortality among prime-age adults in high-HIV areas such as Blantyre, Malawi. A second limitation involved the number of households surveyed, and particularly the number of orphan households. The sample size was simply too low to conduct a sophisticated analysis of food insecurity and its relationship to head of household to further delineate which highly HIV-affected households were most vulnerable to food insecurity. Future research should take the limitations into account in order to build upon these findings.

Acknowledgments

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Summary Report of Regional Technical Working Group Meetings, Nairobi, 1–3 February and 19–21 April 2007

Developing nutrition information systems in Eastern and Southern Africa

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Background*

Child nutrition in most countries in Eastern and Southern Africa has improved only slowly over the past decade, in the face of recurrent drought, economic problems, and the HIV/AIDS epidemic. This highlights the need to ensure that nutrition information is included in early warning assessments and in planning, programming, and evaluation of humanitarian and development programs.

In many humanitarian programs, food aid is the major intervention. Addressing the underlying causes is not always prioritized. Many argue that the most effective way to prevent famines and high levels of malnutrition is to intervene at an early stage in the development of the problem by addressing the underlying or basic causes. Properly designed nutrition information systems can improve decision-making whether for early warning, planning, programming, or evaluation. Nutrition data are available through many different channels whose accessibility and usefulness vary by country. In order to make decisions on programming to better address the causes of malnutrition, national nutrition information systems should be supported and enhanced to allow for improved data collection and triangulation of results from multiple sources.

Nutrition information systems exist in every country in some form. Most exist as a series of separate systems that provide different types of information for different purposes. Systems function at various levels depending on the commitment from government, the level of training of the staff, the degree of need within the country, and the amount of resources that are provided to meet the aims of a surveillance system. Which systems are effective for which purpose varies with context, and comparing experiences from different countries helps to bring out lessons learned.

Nutrition information projects supported by UNICEF in Southern Africa (2003–05, NIPSA) and in the Horn of Africa (2005–07, NIPHORN) consolidated and analyzed nutrition information from the previous 10 to 15 years. These projects also identified key technical issues, including use of area-based nutrition surveys and surveillance systems, on which new research was needed. As part of these projects, two regional workshops gathered together key stakeholders to build on this work, addressing methods for developing sustainable, country-specific capacity, for effective and timely interventions and policies. The long-term project goals included accelerating improvements in child nutrition through the development and utilization of better information systems, and the meetings were seen as steps toward this goal.

A first working group session was held on 1–3 February 2007 to familiarize country teams with research findings, allowing countries to develop plans to further reinforce national nutrition information systems. A follow-up meeting was held on 19–21 April 2007 to make recommendations for specific country situations. This report integrates results from these two meetings. Country reports based on participants' presentations are given in the Annex. The background materials were made available online (http://www.tulane.edu/~internut/index.htm). The results presented on the nutrition situation and related factors (e.g., drought, HIV) have been further developed and are now included in other papers in this issue [1–3], and they are not repeated in this report.

Specific objectives of the Technical Working Group Meetings were as follows:

- To review recent trends in child malnutrition in Eastern and Southern Africa, in particular in relation to drought and HIV/AIDS;
- To make recommendations on key technical issues especially related to sampling, mortality estimation,

Organized through the Nutrition Information Project for the Horn of Africa (NIPHORN), supported by a cooperative agreement of UNICEF ESARO with Tulane University. This summary report is based on notes of the rapporteurs (E. Smith and N. Oliphant) and participants, edited by A. Borhade and J. Mason.

* From introductory sessions, presentations, and discussions.

and indicators used in small-scale nutrition surveys that have emerged during this data analysis and from reviewing current and emerging nutrition information systems in Eastern and Southern Africa;
» To make recommendations for the next steps to further develop nutrition information systems in the region, with particular focus on building the required capacity at the national, regional, and agency levels, to better support interventions to improve nutrition in the long-term, and to mitigate crises.

Methods: Considerations and recommendations

Data sources

Sources of data need to be distinguished by purpose. Trends give the most useful information, often using multiple sources of data. Surveillance can be distinguished into different systems, designed for the following purposes:
» Long-term planning and policy-making
» Program monitoring and evaluation
» Timely warning to preempt and mitigate crises

These objectives are not mutually exclusive, but systems are best designed specifically to meet defined purposes. Usual sources of data include:
» Repeated large-scale surveys (e.g., national Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS)
» Area-level surveys (e.g., 30 households × 30 clusters)
» Reporting systems using data from clinics and screening programs
» Sentinel systems from sites (i.e., clinics) or special ad hoc surveys, including panel surveys

The relation between data sources and uses of the information is illustrated in **table 1**.

Triangulation of data from multiple sources provides a better picture of the nutrition situation in an area than relying on a single source. Trends, where they can be estimated, usually give the most useful information. To develop nutrition information systems at the country level, it is important to determine what information decision makers need, distinguishing between different uses of each type of information.

Improvements in data flow are required in the systems reviewed. This applies from data collection to reporting, and to better and more timely analyses and dissemination of results. In turn, improved political will and public understanding of the meaning of information will help ensure that it is understood and acted upon, together with improved coordination of parallel data collection processes, cross-checks, and timing of surveys to avoid redundancy and allow comparability. Decentralization of data collection and analysis is desirable, but national central databases for ease of access and triangulation of data are also important.

Figure 1 shows an example of how data sources, flows, and decisions on interventions may fit together in practice (taken from the plans for system development in one country).

Sampling methods

Some 900 area-level surveys were completed in the Horn of Africa between 2000 and 2006. The results of analyses of these surveys are given in other papers in this issue [2, 3]. Sampling procedures for these surveys were examined, leading to recommendations for potential improvements. The main question concerns the last stage of sampling, for which the "spin-the-bottle" method (randomly choosing one direction from a central point by spinning a bottle, pencil, etc., and then sampling at fixed intervals along that direction) is convenient and widely used. For rapid surveys, the drawbacks may be less important than feasibility in some conditions, and the simple method is thus justified. The drawbacks of the spin-the-bottle method are as follows:
» It does not require re-counting the population, so errors in population estimates are not corrected, affecting selection with probability proportional to size (PPS).

TABLE 1. Sources of data and their aims

Source	Long-term planning	Program monitoring and evaluation	Timely warning to prevent crises
Repeated national surveys	Yes, main use	Possible but rare, as process data are limited and design is not ideal	No, too infrequent, with long lag times
Area-level surveys	Not usually, but some potential with further analysis	Possible but rare, as process data are limited, design is not ideal, and external validity may be unclear	Main use, together with other data (e.g., crop and livestock prices, rainfall data)
Reporting systems	Not usually. Less reliable than national surveys	Potential use for process monitoring if lag time is reduced	Potential main use if lag time can be reduced
Sentinel site systems	Potential	Potential if carefully designed	Potentially an important use

» Without care, there may be a bias to selection of houses, choosing the most accessible as opposed to relying on random selection.
» It is not suitable for long or irregular habitations, such as those along riverbanks or roads.
» It violates statistical assumptions about known nonzero probabilities of selection, which distorts estimates of design effects and confidence intervals.

The segmentation method corrects for some of these statistical and sampling problems by implementing changes in methodology in the second stage of sampling. This method selects clusters in the first stage in the normal manner, generally with probability proportional to size (PPS), but in the second stage, in lieu of the spin-the-bottle technique, segmentation consists of four steps. First, a sketch map of each selected cluster is drawn, depicting external and internal boundaries and a rough estimation of the location of households. Each cluster is then divided into segments of approximately equal population size on the map. The number of segments is equal to the size of the selected cluster divided by the desired segment size, usually 40 to 50 households. Each segment should contain roughly the same number of households. Increasing the number of segments allows one to decrease the number of households from each segment, decreasing the design effect. One segment is then selected at random (using spin-the-bottle or a similar method for selecting the segment). Households in the chosen segment then constitute the sample. UNICEF includes this methodology for its multiple indicator cluster surveys (MICS) as an alternative to EPI (see http://www.childinfo.org/mics3_manual.html).

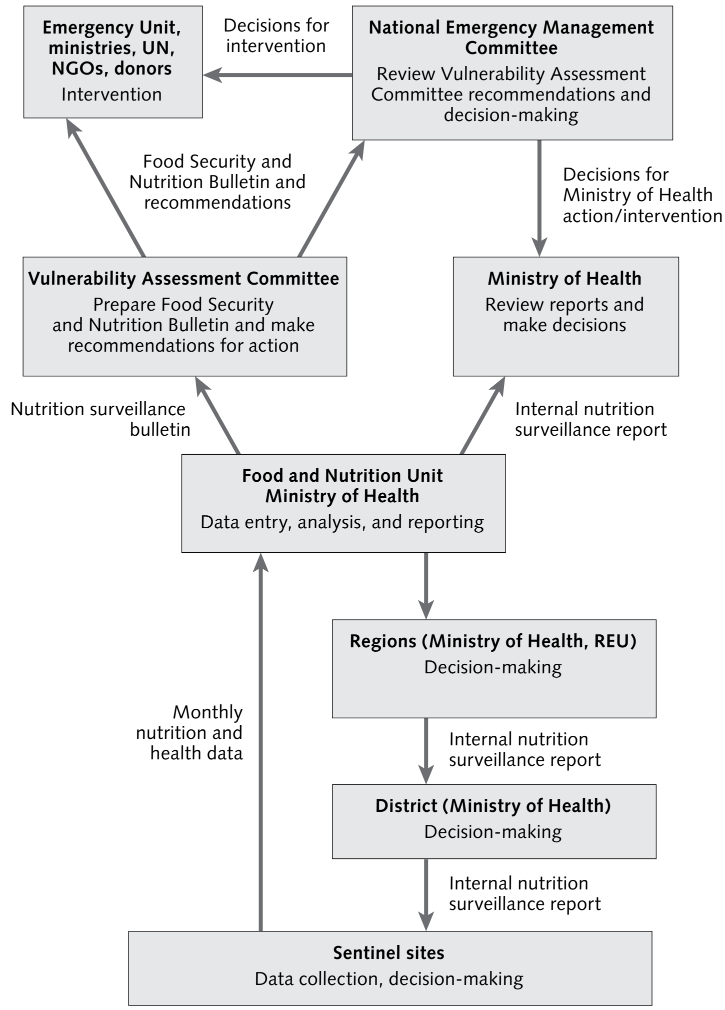

FIG 1. Nutrition surveillance information flow and decision-making process

Recommendations

» Where there is guidance, support, and training for implementation, segmentation is recommended for most survey purposes because it reduces bias, restores probability sampling, improves data quality, allows for more effective monitoring, and allows for use of sample weights. However, it does require more capacity initially than the simpler EPI methodology.
» Until capacity is built, the EPI method should continue to be used, particularly in the following situations:
  – Unstable environments or areas of severe conflict
  – Dispersed populations, e.g., nomadic pastoralists
» When determining which method to use, the purpose of the survey should be taken into consideration. For example, if a rapid estimate of approximate prevalences is needed, (rather than using data for correlational analysis or for assessing trends through time), a simpler method may be appropriate.
» Use census data when available, or other available household listings, for the basis of the sampling frame.
» The number of clusters should be maximized within resources, and numbers selected within clusters need not be extensive; for example, a design with 60 clusters and 10 households per cluster might be more efficient (for nutritional assessment) than the more common 30 × 30 design, because of the clustering (design) effect.

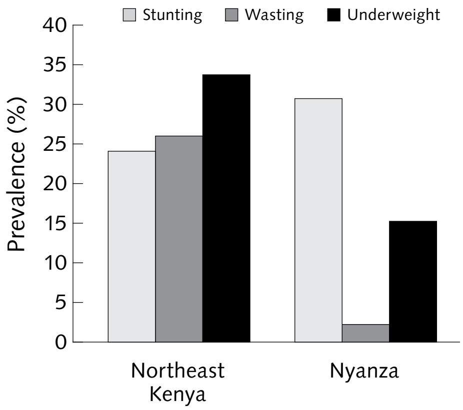

FIG. 2. Differences in prevalences of stunting, wasting, and underweight in two provinces in Kenya

» To assess trends from comparing two surveys at different times, both surveys should use the same sampling frame.

Mortality estimation

Mortality estimates are included in many small-scale surveys, and the results are used to indicate populations affected by drought, displacement, etc. There are concerns that the sample sizes—around 900 is common—may be too low to give useful mortality estimates. Moreover, the confidence bands around the point estimate of mortality are not always given. The form of questions, asking households to recall numbers dying (by age and sex) in a relatively short recall period, was accepted as the most practical. After considerable discussion, the following recommendations were generally agreed upon:

Sample sizes

30 × 30 surveys utilize a sample size of only 900, which introduces considerable uncertainty (i.e., wide confidence intervals) for determining mortality, a relatively rare event. For this reason, in area-level surveys, collecting mortality data is only recommended in an emergency context. Generally, child mortality estimates are more useful than overall mortality and should be the focus.

Recall periods

Recall periods can be flexible, although 90 days is common, and this should be reported to give context for analysis of the data. Long recall periods should be based on a solid reference point (i.e., a major event recognizable to the local community).

Confidence intervals

All mortality estimates should report confidence intervals. Confidence intervals may be lowered from 95% to 80% (and this should be clearly stated), as the implied 80% likelihood of capturing the actual mortality within the narrower range so produced was considered reasonable for supporting judgments on the emergency.

In terms of interpretation of mortality in relation to malnutrition, some preliminary analyses suggested that malnutrition and mortality may have different relationships in different populations. In other words, different populations may have raised mortality at different levels of wasting prevalences. This was further explored in follow-up analyses [3]. The implication is therefore that child malnutrition prevalences should be interpreted with reference to the specific population (defined, for example, by livelihood group), in suggesting associated mortality risks in emergency conditions.

Anthropometric indicators

Comparison of wasting and stunting prevalences within countries revealed that areas with high levels of wasting—and relatively low stunting—are mainly populated by pastoralists, whereas low-wasting, high-stunting areas tend to be predominantly agricultural. This is shown in **figure 2**, where stunting, wasting, and underweight prevalences in children from Northeastern Kenya and Western Kenya (Nyanza Province) are illustrated. The differences between these populations are most clear in wasting: 25% compared with 2%, respectively. In surveys, there is a tendency to prefer wasting (weight-for-height), both because it is easier to measure, not requiring age determination, and because it is sometimes considered more relevant to acute problems. However, as has seen in Southern Africa [4], wasting is usually relatively rare, and underweight is more responsive both to causes and to changes through time.

These differences stem from growth patterns that vary widely among different populations; examples from Uganda and Somalia are given in Chotard et al. [2]. Pastoralists are taller and thinner, and these divergences start in the first year of life; however, pastoralists are not necessarily chronically more deprived, because it is unlikely then that they would be taller than other groups. This divergence in growth patterns does not badly affect interpretation of trends *within* population groups, but it does mean that a wasting prevalence of (say) 10% in central Uganda or Kenya or Malawi may be equivalent in terms of need to (say) a 20% prevalence of wasting in Northeastern Kenya or the Ethiopian lowlands. Relating wasting to mortality in subsequent research clarified this issue [3].

In Kenya, trends smoothed by year and season show that a normal season would expect to see global acute malnutrition (GAM) levels at about 15%, whereas the same analysis done for Ethiopia shows the normal season GAM figures at about 10%. The differences to be expected within season are around 3 to 5 percentage points of wasting prevalence, with larger differences observed between better and worse years [2].

Recommendations

- » A better consensus needs to be developed on the role and relationship of wasting, underweight, and stunting as indicators. This may be different in different contexts and populations, with implications for interpretation.
- » Data should be collected by livelihood zone rather than, or as well as, by district or regional boundaries; more homogeneity is expected by livelihood zone.
- » Using change in an indicator in a population over time rather than absolute cut-off points facilitates interpretation. It was recommended that analysis should be focused more on changes and trends rather than absolute values and cut-offs.
- » Mid-upper-arm circumference (MUAC) can be useful and can be added to small-scale surveys.
  - — At surveillance sites, MUAC alone may be sufficient for monitoring trends.
  - — Research on the relationship between MUAC and mortality is needed, and on the relative selection of population groups by low MUAC or by low weight-for-height.
  - — Standardized cut-offs for MUAC are desirable for both trend monitoring and program admission.
- » Areas for future research and development:
  - — Weight-for-age and height-for-age may be added to small-scale surveys when age can be verified through registration systems, immunization cards, or interview using events calendars.
  - — To keep questionnaires short and concise, efforts should be made to standardize additional information collected through nutrition surveys, to minimize redundancy, and to ensure that additional questions outside of anthropometric indicators should strengthen other information routinely collected.
  - — Finally, each country should develop guidelines on interpretation of the standardized questionnaire indicators and standard reporting procedures.

Collecting data from sentinel sites (clinics, programs, or sample surveys)

Considerable potential exists for gaining data on malnutrition and related factors from measurements already made in clinics, or with contacts made in programs (such as feeding programs). The selection of sites from which data are acquired may be purposive, aimed at detecting change, in which case the sites are known as "sentinel sites." Alternatively, data from all contacts may be compiled, a random sample of sites may be selected, or other selection methods may be used.

Sentinel site systems were ongoing in at least four countries represented, as summarized in **table 2**. There was interest in exploring how a data system based on selected sentinel sites might be developed, and key points from the discussion are summarized below.

The type of sentinel site depends on the context of the country. For example, in Zimbabwe, clinic-based sentinel sites were used originally. As attendance to clinics declined, sentinel surveillance was moved to a household survey methodology for a more representative population sample. This approach can produce large volumes of data that are cumbersome to analyze. For example, in Somalia, delays are experienced such that by the time data are collected and analyzed from the sentinel systems, it may be too late to initiate an intervention.

Interpretation of results

Sentinel site data should be validated through triangulation with data from other sources in the same area.

TABLE 2. Sentinel site designs in Malawi, Kenya, Zimbabwe, and Somalia

Country	Method	Sample size	Weaknesses
Malawi	Data collected monthly from 5 growth-monitoring centers per district selected according to geographic location and livelihood zones	70 children randomly selected	Timeliness of reporting, data quality and flow, lack of involvement of Ministry of Health staff, biased sample
Kenya	Monthly collection from 30 randomly selected households in preselected representative communities	50 children. Visits are repeated every month for long-term trend analysis	Respondent fatigue
Zimbabwe	Currently operational in 23 districts. Data are collected by surveys of randomly selected households in the same villages on each survey throughout the district	300 children per district	Currently no surveillance posts within government, weak comprehensive reporting
Somalia	Data collected from households in 132 sentinel villages in South and Central Somalia according to livelihood zones on a bimonthly basis	50 randomly selected children who are repeatedly surveyed	Respondent fatigue

The data are likely to be useful for trend analysis, but they cannot be compared directly with other national estimates. Sentinel site systems are likely to be more flexible and affordable than a countrywide nutrition information system, but care needs to be taken that only necessary information is captured or staff responsible for data collection will be overloaded, which compromises data quality. To ensure sustainability, one should rely on existing healthcare structures, building their capacity while designing a sentinel site system.

Health center staff issues

» Availability of resources and incentives drives data collection and reporting.
» Regular supervision is important at the village level to maintain enthusiasm and ensure data quality.
» Increase sensitization at all levels of the system to increase demand for data.
» Care should be taken not to overload clinic staff with surveillance work, which distracts them from their regular duties.

Selective feeding centers

Data have a limited use at the national level but are useful in static populations over time (e.g., in refugee or internally displaced population [IDP] camps). They provide a possible source of information on disease trends. It would be very useful to include data from the screening itself (including data on those children not admitted), as well as admission trends. This would provide some information on the population presenting for screening. At the same time, for example, rapid increases in admission could indicate malnutrition problems.

Areas for future research and development

» Sampling guidance should be developed for sentinel sites: What is an adequate number of sites? An adequate number of children? How should sites be selected?
» Longitudinal data collection (i.e., same child, household, or village on each visit) should take into account the bias introduced by revisiting one household or village. It was recommended to explore and document the possibility of changing the village or household after a few rounds to avoid interview fatigue.
» There is a need for cost-effectiveness studies of different types of sentinel surveillance systems and a comparison of sentinel sites versus repeated surveys in terms of cost effectiveness.
» Critical issues of sentinel site data collection included: How often should data be collected? How will the data be utilized? What kind of coverage can the country afford? How will data quality be ensured?
» Livelihood groups often cross administrative boundaries, and clarification is needed as to how far sites represent administrative areas (often the relevant factor for decisions) or livelihood groups (which may influence the type of intervention needed).

Issues common between national nutrition information systems

Several issues affected most of the countries' experiences in developing nutrition information systems, even with the considerable variation between them. These can be divided into three subject areas, which are outlined in **table 3**. Strengthening nutrition information systems should seek solutions to these issues within their program design.

In most countries, particularly those that are affected by regular shocks that pose a threat to the livelihood, nutrition, or food security of populations, multiple stakeholders work to monitor food security and

TABLE 3. Common issues in national nutrition information systems

Skills
» Reporting gaps
» Poor data quality
» Poor data flow
» Long delays before publishing results
» Lack of capacity for analysis and interpretation of data results in a failure to utilize data that have already been collected
Resources and advocacy
» Nutrition information systems are generally costly
» A failure to disseminate information at all levels, but in particular at the community level, leading to a limited understanding of the potential value and role of different nutrition information systems
» An overemphasis on emergency-prone areas and disaster response, with limited funds and attention being paid to long-term monitoring systems
Tools and organization
» Collection of excessive types of extraneous data, with no standard methods for collection or analysis, which are then not useful in analysis and cannot be compared with previous data to analyze trends
» Poor complementarities and comparability between different components of nutrition information systems
» No standardized methodology; methodologic weaknesses in data collection, analysis, and reporting
Information gaps in data type and geographic area
» Poor integration of different components of nutrition information systems
» Lack of a central repository for coordination of both monitoring efforts and information storage and reporting
» Limited use of community-level perspectives in information monitoring isolates community, so systems are less likely to be sustained

TABLE 4. Summary of World Food Programme monitoring systems

Tool	Purpose
Comprehensive Food Security and Vulnerability Analysis (CFSVA)	Household survey done as a baseline in vulnerable areas to assess food security before shocks occur.
Emergency Needs Assessment (ENA)	A rapid analysis done through surveys as an initial analysis after a crisis to determine needs of a community.
Food Security Monitoring System (FSMS)	Continuous and timely data collection and analysis in vulnerable households and communities in a predefined geographic scope. Useful for identifying trends and for providing up-to-date knowledge of household nutrition, food security, and vulnerability, exposure to risks, and potential threats for the food security situation. Currently system is being piloted to combine food security and nutrition.
Vulnerability Assessment Mapping (VAM)	A tool for beneficiary and geographic targeting that collects data on food security and vulnerability information as well as monitoring tools. Reports are released on a monthly basis with situation updates for each targeted area.

nutrition indicators. These stakeholders include agencies, universities, nongovernmental organizations, and ministries. Different stakeholders carry out different kinds of monitoring in order to gather the information that suits their purposes. Currently, large gaps exist in information sharing and complementarities between stakeholders. Often no central repository or coordinating body exists to help with coordination of multiple systems. It is not unheard of for multiple stakeholders to be duplicating work and, due to differences in methodologies and analysis, come up with very different results. Coordination of all of these systems is necessary to create a functioning nutrition information system that addresses the needs of all stakeholders. Coordinating these systems is similar to performing an assessment of needs and determining who can address those needs in the context of each country. Coordination of activities along with a central repository for results can synchronize the processes, allowing multiple data sources to be analyzed and triangulated to come up with a complete picture of nutrition in a country.

As an example, one of the primary concerns of the World Food Programme (WFP) is monitoring and responding to food and nutrition crises in vulnerable areas. WFP is thus primarily concerned with issues of food security. The organization uses multiple different systems to monitor food security and nutrition in the field, as summarized in **table 4**.

The WFP methodology for analyzing food security is to utilize existing data, usually collected by WFP before a crisis as a baseline Comprehensive Food Security and Vulnerability Analysis (CFSVA). In the event a community suffers from a shock that compromises nutritional and food security status, an essential needs assessment (ENA) is done, and the results are compared with the baseline data from the CFSVA. Decisions on appropriate interventions are made by determining the severity of the change from baseline to postshock nutrition and food security indicators.

Food security monitoring systems are now being implemented as regular systems of data collection in highly vulnerable areas. Originally designed to monitor only food security, these systems are now adding nutrition in selected countries on a trial basis. Additionally, vulnerability assessment mapping (VAM) reports provide geographic targeting data and are a tool that is widely used by multiple systems within and outside of WFP to determine the geography of vulnerability.

Summary of technical considerations*

Small-scale surveys

Increased standardization and harmonization of methods is required. Each country should develop and implement a set of nutrition survey guidelines, with the intention of reducing the number of ad hoc surveys done in a year, coordinating the surveys that are completed, and controlling the quality of the data that are collected and the reports produced. These higher-quality data will be more comparable between countries and more credible for use in implementing interventions and garnering donor support.

Sampling and segmentation

Organizations implementing small-scale surveys should be working toward implementing segmentation and phasing out the EPI method, except in areas of high conflict or in highly nomadic populations. Seasonal calendars should be taken more seriously in terms of planning survey timing.

Mortality estimation

Under-five mortality estimation is not ideal, but it is important for comparing with nutrition data, so data of the highest possible quality should be collected. It is recommended to always report confidence intervals and to get an adequate sample size, and to use area-level surveys for determination of mortality only in emergencies. Wider confidence intervals (80%) could be added when reporting mortality.

* From final presentations by P. Hailey (UNICEF).

Data

Data should be measured and analyzed using livelihood zones instead of district and administrative zones to increase comparability across populations. Trend analysis and percentage points of change should be analyzed, comparing them with a population- and area-specific baseline rather than using cut-off points, which are proving to be inaccurate measures for multiple populations. Data need to be analyzed in context.

Indicators

Because of an overabundance of indicators, creating long questionnaires and facilitating enumerator fatigue, it is important to be more critical about what indicators and questions are included in questionnaires. The standardization of questionnaires and reporting methods will allow for easier comparability between surveys.

Developing capacity for national nutrition information systems

As illustrated in the country profiles presented at the workshops (see the Annex), most countries in Eastern and Southern Africa have some form of functioning nutrition information system. These may be through government ministries, and/or with major involvement of nongovernmental organizations, as in Somalia.

The next challenge for each country is determining how to integrate different aspects into a multifaceted program that provides regular, timely, and reliable data on nutrition status, contextually appropriate and able to build on and enhance existing structures. The components functioning in Ethiopia, Kenya, Somalia, and Uganda are summarized in **table 5**.

The challenge is to develop nutrition information systems that are multilevel, with certain indicators meaningful at the community level, together with district and national indicators. These items of information should be linked to key areas that are influencing nutrition outcomes at those levels, so that communities can respond in terms of agriculture and health decisions. In many cases, data already exist but are not being utilized at any level; there is a need to find better ways to analyze and present such data. At the community level, information should be simpler and useful to the community itself. In all countries, there is a need to have a nationally recognized body in order to ensure data of adequate quality and frequency. Development of nutrition information systems should also seek opportunities to integrate with, or build on, health management information systems (HMIS).

A central theme addressed concerned the capacity in countries for nutrition information systems, and how that could be developed and strengthened. First, capacity itself was defined as people having tools and skills, with infrastructure, leading to developing sustainable systems. The needs differ by administrative level, from community through district to national, for example as follows:

Community-level needs:

» Authority to act
» Skills for Assessment, Analysis, and Action (weighing and plotting charts, interpretation of growth data, tallying results, community presentation and utilization of data [e.g., bar graphs], community facilitation skills [discuss problems and come up with solutions])
» Use and understanding of reporting tools, trained by district staff
» Local understanding of nutrition issues, training by district staff [e.g., in courses such as those offered by African Medical and Research Foundation (AMREF)]
» Creation of community support groups—e.g., mother-to-mother support groups
» Supervision from district and national levels
» Communication and advocacy skills

TABLE 5. Components of nutrition information systems in Ethiopia, Kenya, Somalia, and Uganda

System/data source	Ethiopia	Kenya	Somalia	Uganda
Repeated national surveys (from 1990)—no.	6	4	2	2
Ad hoc area-level surveys (from 2000)—no.	399	163	107	100
Reporting systems				
Clinics		CHANIS	FSAU	HMIS
Screening	EOS	NGOs	FSAU	NGOs
Programs	EOS	NGOs	FSAU	CBNP
Sentinel systems				
Survey-based	Follow-ups	ALRMP	FSAU	
Clinic-based	Proposed		FSAU	

ALRMP, Arid Lands Resource Management Project; CBNP, Community-Based Nutrition Program; CHANIS, Child Health and Nutrition Information System; EOS, Extended Outreach System; FSAU, Food Security Assessment Unit; HMIS, Health Management Information System; NGO, nongovernmental organization

There are several examples of community-based dissemination and use of data, including UPHOLD, Uganda; Red Sea State, Sudan; Zambia (referral through community health workers, use of a bar graph to show community status of malnutrition); and Malawi (community health workers and growth monitoring volunteers in each village).

District-level needs:

- Training, mentoring in service
- Skills in data management, analysis, use, and presentation/dissemination
- Local program planning, budgeting, management, supervision, coordination, leadership
- Utilization of reporting network and tools
- Communications and advocacy skills.

National-level needs:

- Data management, including training to allow people to have confidence and skills to manage and analyze data
- Mentoring programs
- Leadership skills
- Management skills
- Communications and advocacy skills

Different training programs will apply to different levels. For example, nongovernmental organizations may focus on the community level and universities on the national and district levels. A "skills audit" can determine the requirements and best approaches at different levels. This may be done through a regional or national coordination group that is familiar with the relevant organizations and their capacities. Linking personnel with academic institutions can help build a staff of qualified people to sustain nutrition information systems.

The *technical skills* needed particularly included the following, which should take priority in developing capacity-building programs:

- Data assessment and analysis
- Public nutrition programming and planning
- Basic epidemiology
- Survey design
- Monitoring and evaluation methods
- Advocacy
- Quantitative and qualitative data management and collection
- Mentoring: support and practice of mobile outreach teams ("roving mentors"); student-to-student, professor-to-student; study groups, tutoring; regional offices, training institutions, United Nations agencies, and nongovernmental organizations; distance mentoring; exchange programs

Decentralized health services have dramatically increased the need for improved skills. This can be addressed (e.g., as in the School of Public Health, University of the Western Cape, South Africa) through different levels of certification and flexible entry and exit points. Much training is provided in a distance format, with participants remaining in their posts and studying part-time while they carry put their regular duties. Mentoring is an essential element, to support skills and systems. One idea is to promote "roving mentors" who can have long-term relationships with people in this area to mentor and ensure skills development and implementation in practice and who are able to provide in-service support for trainees.

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Annex. Country reports

The following reports are based on presentations at the meetings, and thus refer to 2007 or earlier.

Eritrea—Dr. Syeeda Beguum, UNICEF Project Officer, Nutrition

Eritrea has multiple mechanisms in place for monitoring malnutrition in the population. At the national level, Demographic and Health Surveys (DHS) are carried out every 5 years, and there are several types of government-run national surveys. These include monitoring programs done using small-scale surveys, reporting systems such as growth monitoring, health management information systems, and admission rates at community-based therapeutic feeding (CBTF) centers, and sentinel systems in vulnerable areas.

Small-scale surveys are done every 6 months at the district level for all districts (*zobas*) in the country. The results are integrated into the National Nutrition Report, which focuses on trends. CBTFs are located in three zobas and are a rich source of information in terms of trends in admissions and mortality. The sentinel site system is currently being piloted in two zobas and is intended to inform policy makers to launch CBTFs and supplementary feeding programs (SFPs). The sentinel site system includes a clinic-based growth monitoring program, which collects anthropometric indicators (weight-for-age) and admission trends. Sample surveys done in the health facility catchment area collect both anthropometric (weight-for-height) and nonanthropometric data.

Eritrea's system is organized, staffed, and funded entirely by government offices and the Ministry of Health. Some challenges that Eritrea's nutrition information system faces include the timely implementation of surveys, timely release of reports, and the low technical capacity of health workers and lack of feedback to the village level, hindering implementers' view of the utility of the data and lessoning their commitment to collect quality data.

Ethiopia—Dominique Brunet, UNICEF Nutrition Project Officer

Ethiopia's nutrition information system is multifaceted, with responsibilities dispersed to different ministries within the national government. Long-term monitoring is under the Ministry of Finance and Development, and emergency assessments fall under the jurisdiction of the Ministry of Agriculture and Resources, specifically the Disaster Preparedness and Prevention Agency (DPPA). Additional programs, such as the Extended Outreach System (EOS) and Therapeutic Feeding Units (TFU), are housed under the Ministry of Health. The entire system is implemented through the Central Statistics Agency (CSA). Information for the nutrition information system is collected by a combination of seven different methods: Demographic and Health Surveys (DHS), Welfare Monitoring Surveys (WMS), Micronutrient Surveys (MNS), Small-Scale Nutrition Surveys (SSNS), Sentinel Site Surveillance (SSS), Community-Based Nutrition Data (CBND), and Feeding Program Data (FPD). Further explanations of each system can be seen in **table 1**.

Kenya—Bernard Owadi, UNICEF Project Officer, Nutrition

Kenya has multiple decentralized mechanisms for the collection of nutrition data at the national, subnational, and district levels, addressing many of the different needs discussed above. Both Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) are regularly carried out nationally in Kenya. The Kenya Bureau of Statistics also performs occasional surveys. These national-level surveys contain components for nutrition data and are often the main source of data for long-term nutrition strategy and planning.

In the 1980s, the Child Health and Nutrition Information System (CHANIS) was introduced as a method of monitoring growth and morbidity of children under 5 years of age. Data collected from CHANIS include weight-for-age and clinical diagnoses of acute malnutrition. Almost from its inception, however, CHANIS proved to be ineffective and has never really produced or utilized quality data for its intended purposes. Some of CHANIS's more significant shortfalls include understaffing, low motivation and prioritization of collection of nutrition indicators, lack of understanding of the functions and meanings of anthropometric indices, and limited analysis and use of data at all levels.

In terms of early warning systems, Kenya has the Arid Lands Resource Management Project (ALRMP), which depends on sentinel site data collection on a monthly basis. Data collected include mid-upper-arm circumference (MUAC) for children 12 to 59 months of age. Data collection in ALRMP is longitudinal, and analysis is performed from the community to the district level. Data are analyzed for trends based on changes in the percentage of children with MUAC less than 135 mm compared with a reference year. Data are used as an outcome indicator for other household data collected by the Early Warning System. Trends are used to denote a changing situation and to contribute to the phase classification of the area at the district level. Data quality is considered to be fair, and results are utilized

ANNEX TABLE 1. Nutrition data collection systems in Ethiopia

System	Purpose	Implementers	Frequency	Coverage	Targets	Indicators	Method	Issues
DHS	Long-term planning and policy-making	CSA	Every 5 yr	National	Children 0-59 mo and women	WFH, WFA, HFA, BMI	2-stage cluster sampling	Data quality. BMI not adjusted, seasonality, inaccurate results by region, long delays in data analysis and publication of results
WMS	Long-term planning and policy-making	CSA	Every 2–4 yr	National	Children 3–59 mo	WFH, WFA, HFA	2-stage cluster sampling	Data quality, age bands, seasonality
MNS	Long-term planning and policy-making	Ethiopian National Research Institute	Not regular. 1981, 2005	National and regional	Children and women	Vitamin A, iodine, iron	Multistage cluster sampling	
SSNS	Short-term emergency response and program M&E	NGOs and EWD of the Government of Ethiopia	Ad hoc based on EW indicators and donor requirements in NGO project areas	District or livelihood zone	Children 65–110 cm	WFH, MUAC, edema	30 × 30 cluster surveys since 2002. SMART methodology since 2006	Limited geographic coverage. Lack of baseline data. Use limited to GAM or SAM
CBND	Identify acutely malnourished children for TSF programs	Ministry of Health	Every 6 mo	District level, 350 districts	Children 65–110 cm	MUAC, edema	Central screening undertaken along mass campaign of vitamin A supplementation, deworming, and measles vaccination	Data quality, self-elected sample. Frequency, delayed data flow
FPD	Monitoring treatment numbers. Red flag for increasing malnutrition	Ministry of Health and NGOs	Every month	District level	Children 0–59 mo	WFH, MUAC, edema	Data from admission rates from TFU or OTP	Poor and erratic reporting

BMI, body mass index; EW, early warning; EWD, early warning department; GAM, global acute malnutrition; HFA, height-for-age; M&E, monitoring and evaluation; MUAC, mid-upper-arm circumference; NGOs, nongovernmental organizations; SAM, severe acute malnutrition; TFU, therapeutic feeding unit; TSF, targeted supplementary feeding; WFA, weight-for-age; WFH, weight-for-height for decision-making purposes.

Kenya also utilizes ad hoc small-scale surveys (30 clusters × 30 households) for nutritional assessments to gather data in areas that have been previously known to be vulnerable to high levels of malnutrition. Data are collected for children aged 6 to 59 months and include height, weight, age, MUAC, mortality, morbidity, and related nutrition data on immediate and underlying causes. Data flow is cross-sectional at the district or subdistrict level. Development partners and nongovernmental organizations implement ad hoc surveys. Analysis is done by the implementing agency using standard statistical packages. Currently there are no standard data collection or reporting protocols, so the results and quality can vary depending on the implementing agency. Data are mainly utilized for emergency programming.

Malawi—information from UNICEF Office

Malawi's nutrition information system consists of several different types of surveillance orchestrated primarily through the Ministry of Health and the National Office of Statistics. One of the strengths of the Malawi system is its ability to integrate multiple sources of information to produce a system designed for short-term emergency response and monitoring of nutrition status. One of the major successes is the use of the National Nutrition Survey as a tool to provide information for dealing with potential or current crises. Success in using a nutrition survey for informing rapid response is dependent upon rapid analysis of data. To address this issue, provisional analysis focuses on a few key indicators allowing for rapid reporting and timely response.

The Malawi system also includes health management information system (HMIS) data for routine monitoring and planning, area-level surveys for short-term emergency response, a school-based health and nutrition survey, national-level surveys, and vulnerability assessment. All of these systems are coordinated and supported through a mentorship and supervisory program run jointly through multiple stakeholders to ensure, as much as possible, the collection of quality data and timely reporting and response.

Somalia—Grainne Moloney, Food Security Analysis Unit/Food and Agriculture Organization, Nutrition Project Manager

Somalia has a complicated nutrition situation, which has been addressed primarily through development partners and nongovernmental organizations. Prior to the conflict in 1991, coordination was managed under the Ministry of Health both at the national and the regional level. Now all sector coordination is under one governing body, the Somalia Support Secretariat (formerly the SACB), supported by the United Nations Development Programme (UNDP). In addition, a nutrition working group and a nutrition cluster are coordinated and cochaired by UNICEF and the Food Security Analysis Unit (FSAU). The nutrition working group holds monthly meetings with UN organizations, nongovernmental organizations, and community-based organizations in Nairobi to discuss updates on nutrition information, emergency response, health, food security, logistics, and new developments. Regional meetings are also held within Somalia, but timing and frequency vary depending on location and on access and availability of partners. Indeed, the biggest challenges facing the Somalia nutrition information system are the lack of government, safety issues leading to lack of access, and lack of technical staff in the field.

Somalia has a variety of sources of information available for collection and analysis. At the national level, UNICEF sponsored Multiple Indicator Cluster Surveys (MICS) in 1999 and 2006, and at the local level, through collaboration between UNICEF and FSAU, a well-organized and comprehensive system of nutrition data collection has emerged. This multifaceted approach includes:

- The production and endorsement of National Nutrition Guidelines that are updated on a yearly basis by UNICEF and FSAU in collaboration with the Nutrition Working Group members.
- Nutrition surveys conducted by UN agencies, predominantly FSAU, with support from UNICEF, the World Food Programme (WFP), and nongovernmental organizations (Médecins sans Frontières-Belgium and Holland, Action contre la Faim, International Medical Corps, World Vision. Surveys are often done on an interagency basis as recommended by the Nutrition Working Group. Surveys are done in areas of nongovernmental organization operation and in areas of concern or where there is no data.
- Collection of feeding center statistics.
- Sentinel sites set up at a village level. Data are collected bimonthly from 102 sentinel villages in South and Central Somalia. Fifty children are interviewed and anthropometric data are collected from them, including weight-for-height, mid-upper-arm circumference (MUAC), edema, morbidity, and dietary diversity information.
- A MUAC rapid assessment tool, adapted from Darfur, for rapid assessment of vulnerable populations.
- Health Information System data collected from 105 health centers throughout the country. Data collected include weight-for-height for all children aged 6 to 59 months, morbidity, epidemiological survey data, and maternal health.
- Additional information on dietary diversity, childcare feeding practices, and underlying causes is collected through sentinel sites and nutrition assessments.

» All data are collected in a database, held, and updated by FSAU and undergo ongoing analysis of seasonality to review trends in malnutrition over different seasons and over time.

FSAU has a variety of methods of dispersing data and analysis results. Outputs include:

» Monthly nutrition updates
» Quarterly food security and nutrition briefs
» Biannual Integrated Phase Classification System (IPC)—seasonal analysis—nutrition situation map
» Nutrition assessment reports
» Training materials (food preservation, hygiene promotion, micronutrients)
» All materials are available on the FSAU website (http://www.fsausomali.org/).

In addition to nutrition assessment, FSAU houses a food security analysis team. Through the identification of a need to review nutrition indicators due to the heavy reliance on weight-for-height and mortality data only available from localized assessments that may not be representative of larger areas and across seasons, the food security analysis team developed the Integrated Phase Classification System (IPC) to triangulate a series of different indicators to produce an overall picture of vulnerability in terms of nutrition. The food security project collects information on market prices, livestock, agriculture, security, and climate (through the use of data produced by the Famine Early Warning Systems Network (FEWSNET). Two main assessments linked to the rains are conducted annually, in June and December. In addition, quarterly briefs on risk factors and early warning are produced incorporating nutrition and food security information. The IPC is seen as a valuable tool for decision makers and donors and is currently being adapted in the Horn, East, and Central Africa regions.

Despite being well funded and well organized, the fact that it is operating within Somalia creates inherent problems for FSAU. Access to conduct quality large-scale assessments is limited; the inability of international staff to enter the country and the lack of trained local staff lead to a lack of capacity on the ground. Partners working on the ground tend to be concentrated in certain areas, leaving vast information gaps in other areas, and the lack of government means there is a lack of structures for long-term integration of monitoring systems. The lack of trained staff and limited supervision brings the quality of data collected on the ground into question. The variety of ethnic groups and livelihood status makes comparison across populations difficult, and the high numbers of internally displaced people (IDP) create another level of complexity for monitoring populations, as they have different needs than a settled people.

Somalia's complicated political, social, and cultural framework makes monitoring and comparison across populations difficult. Currently, in terms of response, only high levels of wasting trigger interventions, but as shown in the NIPHORN project, not all populations express nutritional strain at the same levels of wasting. There is a need to further link nutrition assessments to seasonality and livelihood zones for better trend analysis and interpretation of results over time to allow for these differences in populations. The IPC is an attempt to contextualize nutrition indicators to provide a better understanding of nutrition situations in terms of environment and livelihood to allow initiation of a more appropriate response.

Tanzania—Said Aboud, National Bureau of Statistics, Director of Population and Social Services

Nutrition Surveillance Systems (NSS) in Tanzania started as early as 1980 with the introduction of data collection systems at the national, district, and community levels, based on existing maternal and child healthcare systems. The main objective of the NSS is to provide decision makers with multiple levels of nutrition information for use in policy-making. Data collected include anthropometric indices such as weight-for-age, disease monitoring, and early warning information and crop assessments.

The Tanzanian NSS has not been a successful method of data collection and trend monitoring due to multiple challenges, not the least of which being the lack of national prioritization to issues surrounding nutrition. As a result, information, if received from the village and district level, is often late and unorganized, making the compilation of data from multiple sources near to impossible. In terms of funding, capacity is insufficient at all levels, creating a dependence on development partners for a majority of the funding. The shortage of manpower at all levels means that long and cumbersome forms are often shelved or filled out improperly, leading to questionable data quality and spotty coverage. Finally, the lack of supervision creates the overall impression that nutrition is simply not a priority, and this lack of attention causes the deterioration of an already weak system.

Recent changes in the international profile of nutrition, and an increased appreciation of the costs of a malnourished population, as well as an increase in recurrent natural disasters and the rising profile of nutrition issues, have inspired the Government of Tanzania to lead a move to revitalize the NSS. Nutrition has even become a mandate prioritized in the second phase of the Poverty Reduction and Economic Recovery Program, known as Mkukuta.

Revitalization plans include decentralization of the system, the development of a coordinating body for the NSS, a national workshop to sensitize citizens to the importance of nutrition and nutrition information, and piloting in a few districts initially, leading to a scale-up in the future. The system is still under design, but the government plans to link the NSS with the national monitoring system and the national database for data collection and analysis. Tanzanian representatives expressed some skepticism about the successful implementation of an NSS. Three requirements for success were mentioned:

- Mainstreaming nutrition data collection with the national data collection and information management system;
- Increased social collective consciousness about the contribution nutrition will make to development;
- A strong link between information and action.

Uganda—Michael Mawadri, World Food Programme, Programme Assistant, Nutrition

Uganda's nutrition information system is intended to guide policy formulation, advocate for underserved populations, provide program monitoring and evaluation, guide nutrition interventions, prevent and mitigate crises, and provide early warning. The system is informed through:

- The Health Management Information System (HMIS), which collects data through tally sheets and registers at the health center level. These data are compiled into monthly reports on health and epidemiology for all districts. Nutrition indicators are not currently reported.
- Mother and Child Health Nutrition Reports done through nongovernmental organizations;
- National Surveys—e.g., Uganda Demographic and Health Surveys (UDHS), conducted every 5 years since 1989;
- Growth Monitoring Programs (GMPs), health facility and community based; data not currently reported;
- Ministry of Health weekly Epidemiology Newsletters;
- Annual Nutrition Surveys, area level, especially among vulnerable populations (internally displaced people, and refugees).

Uganda's GMPs are implemented at the community level with support from nongovernmental organizations. This has proved to be a useful method of ensuring data quality and improving mothers' education through increased training and supervision at the village and district levels. The GMP and HMIS programs have found that giving data results back to the community facilitates a higher level of participation in both monitoring and reporting at the health center and community level. The publication of district-level reports detailing district-specific immunization coverage and morbidity on a monthly basis in the local newspaper creates a level of competition between communities, which in turn enhances coverage and reporting.

Uganda's nutrition information system has faced some challenges, including determining proper indicators to collect, particularly in the case of feeding centers; reporting without leaving out problem areas; capacity-building at the community and healthcare worker levels; standardizing guidelines for data collection methodology and uniform interpretation in area-level surveys; and reporting challenges. The country's system has a great deal of potential to expand into a fully functioning nutrition information system with further training and capacity-building at all levels, and increased focus on collecting and reporting anthropometric data.

Zimbabwe—Adam Bailes, UNICEF Project Officer, Nutrition

Zimbabwe's nutrition information system was implemented through the Food and Nutrition Council in collaboration with the National Nutrition Unit of the Ministry of Health and Child Welfare. The nutrition information system was initially put into operation as a pilot in November 2004 with the first of a biannual sentinel site data collection process aimed at gathering data for the purposes of informing and influencing programming, early warning, and monitoring trends. Three more rounds of data collection were carried out in March and November 2005 and in October 2006.

The initial pilot exercise chose one district per province, identified as vulnerable through Vulnerability Assessment Committee (VAC) results, and 10 villages from each selected district. Thirty children were sampled in each village. The two largest cities, Harare and Bulawayo, were also included. The third and fourth rounds scaled up sampling to include two or three districts per province and two or three villages per district. The same villages were sampled on each round, with a random selection of households. Collected indicators included anthropometry for children 6 to 59 months of age, health indicators, water and sanitation, hunger, vitamin A supplementation, household salt intake, iodine deficiency disorders (IDD), breastfeeding, orphans and vulnerable children (OVC) status, and chronic illness and morbidity in households.

An additional method being researched for future data collection includes collecting a rolling sample, where half of the sampled villages will be repeats from the last survey and half will be new villages. The rationale is that at least two data points can then be used for trends without the bias introduced by repeatedly sampling the same villages.

In addition to the nutrition information system, Zimbabwe also utilizes the VAC system of monitoring for early warning. Timing between sentinel surveillance and VAC surveys is coordinated between both systems to maximize coverage. VAC is well established in Zimbabwe and is a valuable source of early warning data. Additional sources of information include Demographic and Health Surveys (DHS), National Nutrition Surveys (NNS), Health management Information

System (HMIS), therapeutic feeding statistics, and the micronutrient survey.

The nutrition information system has been accepted and approved by the Government of Zimbabwe and is now recognized as a means of regular data collection and reporting. The system has proven to be flexible and has adjusted rapidly based on lessons learned. Still, combining multiple data sources for more comprehensive reporting is weak. Integration of the structure of the nutrition information system, utilizing multiple sources of information to establish context within the country, and increasing posts within the government to increase sustainability, capacity, and prioritization would be vast improvements in the system.