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Department of International Health and Development

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John B Mason, Sophie Chotard, Megan Dieterich, Nicholas Oliphant, Erin Smith, Jonathan Rivers, Peter Hailey and Saba Mebrahtu.

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Department of International Health and Development
Tulane University School of Public Health and Tropical Medicine
1440 Canal Street, Suite 2200
New Orleans, LA 70112
ph. 504-988-3655 | fax 504-988-3653
www.sph.tulane.edu/~inhl

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

John B Mason, Sophie Chotard, Megan Dieterich, Nicholas Oliphant, Erin Smith, Jonathan Rivers, Peter Hailey and Saba Mebrahtu.[1]

ABSTRACT

Objective: To estimate levels and fluctuations in wasting prevalences in children from surveys conducted in arid and semi-arid areas of the Greater Horn of Africa, by livelihood (pastoral, agricultural, mixed, migrants), season or month, and year from 2000-2006.
Design: Compilation and analysis of results from about 900 area-level nutrition surveys.
Setting: Data from surveys carried out largely by non-governmental organizations, coordinated by UNICEF, in vulnerable areas of Eritrea, Ethiopia, Kenya, Somalia, S Sudan, and Uganda. DHS and MICS data used for comparisons.
Subjects: Secondary data: children 0-5 years (or less than 110 cms) measured in small-scale surveys (typical sample size about 900).
Results: Pastoral child populations on average have wasting prevalences (<-2SDS wt/ht) about 17%, 7 percentage points higher than agriculturalists or mixed livelihoods, which average about 10%. Fluctuations are greater in pastoralists in worse-than-average years, rising to 25% or higher; agricultural populations seldom exceed 15%. This difference may be related to very different growth patterns (assessed from DHS and UNICEF/MICS surveys), whereby pastoralist children typically grow up thinner but taller than agriculturalists. Thus pastoral children have higher wasting prevalence on average, and this increases more than others in lean times. Wasting peaks are seen in the early half of the year, usually the dry season, linked to 'hungry' or 'lean' and moderately hungry seasons. In average years the seasonal increase is about 5 ppts. Internally displaced and urban migrants have somewhat higher wasting. Year-to-year differences are the largest, loosely correlated with drought at national level but subject to local variations.
Conclusions: Tracking evolution of wasting through time at area level (Oromia and Somali Regions in Ethiopia, and Rift Valley Province in Kenya are used as examples) facilitates interpretation of at-one-time survey results. Roughly, exceeding 25% wasting in pastoralists and 15% in agriculturalists (taking account of timing) are warnings of unusual malnutrition levels. Different populations should be judged by population-specific criteria, and invariant prevalence cut-points avoided. Interpretation of survey estimates of wasting, when seen in the context of historical values and viewed as specific to different livelihood groups, can provide important timely warning of the need for intervention to mitigate developing nutritional crises.

[1] Peter Hailey and Saba Mebrahtu are with UNICEF, Eastern and Southern Africa Regional Office, Nairobi; other authors are affiliated with the School of Public Health and Tropical Medicine, Tulane University. Correspondence to masonj@tulane.edu

INTRODUCTION.

Populations in low-rainfall areas of the Greater Horn of Africa (GHA: Eritrea, Ethiopia, Kenya, Somalia, Sudan, Uganda) are recognized as particularly vulnerable to food insecurity and malnutrition. The vulnerability stems from the environment itself, with much dependence on cattle-raising and with nomadic or semi-nomadic lifestyles a common – but increasingly threatened – livelihood adaptation. The threats are from erratic climatic conditions – likely to become more so – and from competition for resources and political instability. International agencies have long been concerned to protect people from severe food shortages in the short term, as well as to foster developments that will reduce vulnerability, on which progress is slow.

Judging the requirements for emergency intervention to mitigate threats to nutrition depends on various sources of information, often including considerations of the extent of child malnutrition and directions of change in this. Of the several warning systems, the most developed example in the GHA is probably the Food Security Analysis Unit for Somalia[2], which employs a set of data ranging from rainfall reports and satellite imagery to household surveys, including child nutrition (FSAU, 2006). Ethiopia, as another example, has an early warning system linked to nutritional surveillance (e.g. ENCU, 2006).

Recognizing that nutritional indicators may change late in the process of a developing crisis, they nonetheless are widely used to provide a direct and objective estimate of current status. With very limited nutritional information regularly available, measuring child nutrition in the vulnerable areas currently depends largely on cross-sectional area-level surveys, typically with sample sizes of about 900 (30 houeholds by 30 clusters), carried out at a few weeks notice, with initial results put out within a few weeks further. Because of difficulties in estimating age, these surveys usually rely on thinness, or wasting, in children as the measure of nutritional outcome. The main issues addressed here concern the interpretation of levels, trends, and variations in wasting prevalence estimates, for different populations.

Differences in wasting prevalences occur by livelihood, season, and year-to-year conditions. Added to this, there are concerns that when surveys are repeated in the same areas – although not rigorously sampled from exactly the same populations – quite large fluctuations are sometimes seen, and there is uncertainty as to whether this represents real change as expected variations are not well known.

While differentials by livelihood are seen in these populations – typically between pastoralists and others (e.g. from DHS and MICS surveys) –the significance is not widely agreed, although very relevant in the context of the GHA. On the one hand, WHO (2000, table 20) puts forward a classification for severity of malnutrition (at population level) based on prevalences of wasting irrespective of population (e.g. 10-14% is serious, >=15% critical), and similar invariant trigger levels for intervention are adopted by many

[2] http://www.fsausomali.org/index.php

guidelines (e.g. SPHERE, 2004). On the other hand, it is recognized in studies of pastoralists that their growth patterns differ from those with other livelihoods (Gray et al, 2004; Ruff, 2002; Little et al, 1993), and their typically higher wasting prevalences, with lower stunting, may influence interpretation of patterns of malnutrition. As a readily available example, prevalences of wasting in NE Province of Kenya (mainly a pastoralist population) were 14-27% in 2000-3, compared to 8-10% in Nyanza (mainly agricultural: UNICEF/MICS, 2000; Measure/DHS, 2003); stunting was respectively 27-38% in NE compared to 36-41% in Nyanza. Moreover, as stunting is generally lower in pastoralist than in other populations, so that the persistently higher wasting does not match a simple picture of chronic malnutrition. Here we examine the levels and trends in wasting, in pastoralist and other livelihood groups.

Variations by season are less well established, as most large surveys are infrequent and not matched by season. However previous data from clinic reports from nine African countries (ACC/SCN, 1989, p 21) indicated seasonal fluctuations of around 5 ppts in low wt/age. Studies in southern Ethiopia concluded that seasonal weight changes, while significant in adults (about 1.5 kg between seasons) (Branca et al, 1993) were not significant in children. In Gambia, wasting fluctuated between about 4 and 10% between seasons (Tomkins et al, 1986). In Zimbabwe underweight varied in some areas only, and then by 1-2 ppts (Wright et al, 2001). The largest reported seasonal fluctuations in wasting reported was in children in Mali (Loutan and Lamotte, 1984) of 10 ppts, 7% to 17%. Knowing the typical seasonal fluctuation in the GHA vulnerable populations should be useful both for assessing the severity of malnutrition at one time, and to some extent predicting early, from prevalences at a better time (e.g. post-harvest), how far they are likely to rise with the onset of leaner times.

Year-to-year changes can be assessed at national and provincial levels from repeated national surveys (see Mason et al, 2007; Chotard et al, 2007). However, these do not have the sample size necessary to assess changes in relatively small populations – at district or lower levels, in the typical E African administrative structure. (In fact, the NE Province data from Kenya cited above stem from less than 200 cases per survey.) Provincial wasting prevalences are generally in the 5-10% range in non-pastoralist areas (Chotard et al, 2007), and are useful to give context to more rapidly available surveys but are seldom available in adequately real time to help in intervention decisions. Small scale area-level surveys are the better source.

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

Thus the issues addressed here concern whether we can provide more situation- and population-specific guidance on what levels and fluctuations are indicative of a need for

urgent emergency intervention; and by contrast, what are to be expected in a typical year or season. This paper describes the patterns seen since 2000 as a basis for this. In a future paper, the relation of mortality estimates to wasting will be described, as a further means of providing context for interpretation.

Because of concern for food insecurity and severe malnutrition, a large number of area-level surveys were conducted in recent years, accelerating with widespread drought from 2000 on. Most of these were conducted by NGO's, with UNICEF coordination in many cases; for Somalia the FAO-led FSAU (based in Nairobi) was the focal point. As part of ongoing research sponsored by UNICEF, we collaborated in compiling the results of small scale surveys carried out from the beginning of 2000 to early 2006. A total of 905 survey results were compiled from six countries (Eritrea, Ethiopia, Kenya, Somalia, Southern Sudan, and Uganda), with typical sample sizes of around 900 pre-school-age children, thus the results derive from measurements on nearly one 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.

< fig 1 near here >

METHODS.

Surveys.

All the survey results compiled were obtained from survey reports, made available through UNICEF (E and Srn Africa Regional Office, ESARO). The surveys were conducted by non-governmental organizations (NGOs), 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 (DPP – Disaster Preparedness and Prevention Dept) 14%; GOAL 14%; CONCERN 13%; CRS 5%; IMC 5%; 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/child, usually with 30 clusters selected then 30 households/children – generally following the standard procedures based on CDC methods, as described for example in SMART (2006). 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 neighbouring households until a child was identified. With more than one child per visited household either both were measured or the youngest. In most cases children's eligibility was based on height (60-110 cms) rather than age (up to 60 months), but as these two are largely equivalent choice of one method will affect results little.

Eight sets of original data were available for some additional studies (reported elsewhere – Chotard et al, 2007, p 34)), and these also provide some information on data quality. These were: Sool, Somalia, June 2003, n=901; Gulu, Uganda, Oct 2004, n=5451; Kotido, Uganda, August 2004, n=931; Moroto, Uganda, August 2004, n=952; Nakapiripirit, Uganda, August 2004, n=897; Akobo, S Sudan, September 2005, n=925; Kajo Keji, S Sudan, June 2005, n=915; Jilibi, Somalia, May 2004, n=913. Descriptive results in the next paragraph are from these.

Age was recorded in most surveys, but 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. Oedema was also recorded, but with low prevalence (less than 1%). Unfortunately many surveys reported only the combined total of wasting (< -2SDs wt/ht) plus oedema, referred to as 'Global Acute Malnutrition (GAM)', which in principle is not an exclusive combination (some children could be wasted and oedematous). In practice, the oedema prevalence is low (mean 0.8% in the eight datasets, range 0-2.2%) and only partly overlaps with wasting. GAM and wasting prevalences are similar (UNICEF, 2003), and GAM is taken here as equivalent to wasting for these analyses.

Month of survey was recorded in most cases, and where not enquiries were made as to the season and this recorded as 'moderate hunger, hungry, or post-harvest'. The major livelihood of the population surveyed, as agricultural type (pastoralist, agro-pastoralist, or agriculture (usually riverine)) was assessed from the survey reports; alternatively some surveys were of camps of displaced people, or in urban settlements. A number of other factors were included, e.g. whether drought, floods, or conflict, were considered the main risk, and these too were coded.

Dataset.

Results from 897 surveys were assembled into a dataset (in SPSS), each case being a survey result (*SEMmerge4Jan08JM.sav*). This was in two stages, in late 2005 and updated in mid-2006 both with newly identified surveys and those recently carried out. Duplicates were removed. Prevalences of GAM (referred to here as wasting as this is far the main component) ranged from 1 to 44%, and all these values were included.

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

Areas. The primary designations were country and province or region (*region, regnum*). For certain analyses, Ethiopia was divided into the lowland regions (Afar and Somali), mainly pastoralist, and those of higher elevation with more dependence on agriculture (Amhara, Oromia, SNNPR, Tigray), designated Ethiopia (A-S) and Ethiopia (other) respectively (*c_code2*).

Season. Harvest times vary within countries, but here a standard designation by country was used, from a crop calendar constructed from harvest timing (FAO [3]) and local enquiries. Harvests were taken as follows: Ethiopia, November-December; Kenya, Sept-Oct; Somalia, August-September; Sudan, November. The seasons were thus coded as: Ethiopia (Afar and Somali regions), moderate (M) April-June, hungry (or lean, H) July-October, post-harvest (P) November-March; Kenya, M February-May, H June-September, P October-January; Somalia, M Jan-April, H May-August, P, September-December; Sudan, M February-May, H, June-August, P, September-January; in Uganda seasonal variations are less pronounced and were not coded (all months defined as moderate season). When survey month was not recorded, season was assigned based on other information in the report or from further enquiries: this applied to 233 cases (month not reported) and a code (*season2*) 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 (*d_mod2*) and hungry (*d-hung2*) seasons, with post-harvest as the excluded group in regressions. These designations derive from crop calendars, and for pastoralist populations the times of food shortage may be somewhat earlier, as livestock production may start to recover sooner after than rains start than the crop harvest – the dry season may thus be an important definition for these populations, corresponding to parts of the moderate and hunger seasons.

The post-harvest season bridged calendar years (e.g. October through January in Kenya), so that seasons were recoded by country sequentially (*season3*), from 0-21 for the 7 years (e.g. for Kenya: 0 was post-harvest in January 2000, 1 was moderate Feb-May 2000, 2 hungry June-September 2001, 3 post-harvest October 2000 through January 2001, and so on finishing with post-harvest 2006 as 21). This was applied where seasons were most important, i.e. Kenya, Somalia, Sudan and Ethiopia (A-S). Months were also coded cumulatively (*totmonth*) 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, pastoralist, riverine agriculture, agro-pastoralist (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 S 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 (variable = *liveli2*) simplified analysis and allowed Sudan to be satisfactorily included in the regression analyses. Dummy variables were derived for each category as shown in later tables, with agriculture the excluded category, except in Kenya for which agro-pastoralist was used. There were no missing values.

Risk factors. A number of surveys were done because of specific concerns – drought, floods, insecurity, and of returning IDPs. Where reported these were recorded, but in all cases except drought over 80% of the values were missing. Differences in non-missing values between factor present or absent were of the order of 2 ppts. This was not directly

[3] E.g Oct 2005 ftp://ftp.fao.org/docrep/fao/008/J6398e/J6398e00.pdf

pursued further. Drought was not reported consistently, by year or area: 151 cases were positive (out of 260 non-missing) It was used as a dummy variable (1 = drought report, 0 = drought specifically not reported or missing; *d_dr2*). This 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 has been assessed quantitatively at national level, and an annual measure derived for the difference in crop production index from the trend, by country, as reported in Mason et al, 2007[4]. 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 semi-arid lands which are overall relatively minor contributors to national production, and subject to local drought risks that may not affect other areas as badly. Moreover the production-based estimates are annual. Conditions in vulnerable sub-national areas by season can be looked up (including retrospectively) in FAO's Foodcrops and Shortages reports[5].

Analysis.

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

Additional data: DHS.

Some additional analyses were done comparing pastoral and agricultural groups, controlling for SES, 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. Prevalences of wasting and stunting were derived as less than – 2.0SDs from the weight-for-height and height-for-age variables in the datasets. SES 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, Oromia and Somali Region were selected (having the largest samples of small-scale surveys thus being the most useful for comparison), and within these the ethnic groups Oroma and Somali, generally agricultural (or agro-pastoral) and pastoral respectively. In Kenya, Rift Valley was selected (mixed livelihood), having the most small scale surveys, and North Eastern Province, mostly pastoralist, for comparison. The Somali and Turkana group were selected as mainly pastoralist, compared with others who were agricultural (Maasai were intermediate and omitted for simplicity).

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[4] For guidance, the results indicated that production was as follows for the countries with data: Ethiopia, low in 2000, higher in 2001-2, down somewhat in 2004-5; Kenya and Uganda, good harvests in 200-13, shortfalls in 2004-5. No data for Somalia or S Sudan.

[5] http://www.fao.org/giews/english/fs/index.htm

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 prevalence of children of low wt/ht ('wasting') as the dependent variable. The surveys do not provide a representative sample, in time or by location 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 may be among pastoralists in the hungry season, others with agriculturalists post-harvest – but as far as feasible we need to compare these. Therefore the multiple associations have to be first examined, then generalizations are made adjusting for the heterogeneity of the survey circumstances.

The distribution of the surveys in terms of seasonal timing is shown in table 1A, and by livelihood in table 1B. More surveys were done in the moderate (i.e. moderately hungry or lean) season than others, 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%) covered pastoralist populations; whereas (for example) in Ethiopia most were agriculturalists. Surveys of internally displaced populations (mostly in camps) predominated in Uganda, with a number also in Somalia and Eritrea. The population 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 NE 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 pastoralist or agro-pastoralist they are defined here by their urban location.

< table 1 A and B near here >

Overall mean child wasting prevalences by country (pooling livelihoods, seasons and years) are also shown in table 1A (last two rows). The populations in Kenya (NE), Afar and Somali regions of Ethiopia, and S Sudan (i.e. the predominantly pastoral and agro-pastoral groups) have prevalences around 20%; Uganda and the other (more agricultural) regions of Ethiopia have prevalences around 10%; Eritrea and Somalia are around 15%. Mean prevalences adjusted for covariates (year, season, reported drought) are also given (significances are in the footnote), and these are similar to the unadjusted means.[6]

[6] http://www.measuredhs.com/pubs/pdf/FR151/10Chapter10.pdf for Kenya NE vs rest

Regression models controlling for livelihood, season, and year, with dummy variables added for country (table 2A), confirm that controlling for livelhoods the wasting prevalences are significantly different between countries with higher and lower prevalences. In this model the livelihood variables become insignificant when the country dummies are included, as livelihood tends to be collinear with country, 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 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. Results quoted below all refer to effect sizes controlling for other factors, from these models.

< tables 2 and 3 near here >

Livelihood.

The first results column ('all') in table 2B combines the data from populations in the six countries. Pastoralist groups had 6.7 ppts higher wasting than 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; $p < 0.001$). Urban groups were also significantly higher (8.6 ppts more than agriculturalists) with an adjusted mean of 19.1%, presumably reflecting migration and poverty more than livelihood pattern itself. Children in displaced populations (IDPs) had 14% wasting prevalences, significantly raised. In the surveys from S Sudan livelihoods were not defined, but overall the prevalence is estimated to be 21%, similar to Kenya and Ethiopia (Afar and Somali).

Within countries (see table 2B) the pastoralist group usually has a higher prevalence than agriculturalists: this is significant in Ethiopia (all) and Uganda; and in Kenya (comparing with agro-pastoralists). The average wasting prevalences among pastoralists in the lowland areas (i.e. excluding Ethiopia (Amhara, Oromiya, SNNPR, and Tigray) is 17-21%, compared to 7-10% among agriculturalists in non-pastoral areas. Agro-pastoralists – that is populations dependent both on livestock and crops – are intermediate, and have lower prevalences in less-pastoral areas (Ethiopia – Amhara etc) and Uganda.

In these surveys IDPs were found mainly in Uganda, as well as Somalia and Sudan. The prevalences were higher by around 4 ppts (see regression; in most countries the coefficient is significant) than non-IDPs in the same country. The urban populations surveyed – most in Kenya – were mostly migrants and thus with some similarities to

IDPs; these also had prevalences significantly above other livelihood groups in Kenya and Ethiopia, by about 10 ppts.

Differences between children of pastoralists and those growing crops 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 and Uganda (MICS, 1999; and DHS, 2001), shows the striking pattern in figure 2A: Ugandan children start with less than 10% stunting or wasting at < 6 months, increasing rapidly to more than 40% after 12 months, with no increase in wasting; Somali children start with around 20% stunting and wasting, and both continue at around this level. Clearly the growth patterns of these groups – broadly pastoralist and agriculturalist – are very different. Growth measured by weight is more similar between groups, as thinness and stunting balance each other (figure 2B); thus underweight may be more comparable between different livelihood groups.

< figures 2 A and B near here >

Wasting levels among pastoralists and agriculturalists from recent DHS surveys in Ethiopia (2005) and Kenya (2003), which provide results drawn from samples representative of the populations, are shown in figure 3. Agricultural or agro-pastoralist populations have child wasting around 10%, such as the Oromo people in Oromia and the non-Turkana groups in Rift Valley. Wasting does decrease with less poverty, e.g. from 10.8% to 8.5% in Oromo in Oromia, or 8.6% to 3.8% in other (agricultural) in Rift valley, using roofing as a proxy (tin roofs indicating less poverty than grass). The Somali population in Somali Region in Ethiopia had 24% wasting, not changing with wealth; in NE Kenya this group had 27% wasting, decreasing to 11% with less poverty (tin roofs). Stunting was similar in both pastoralists and agro-pastoralists, decreasing as expected with less poverty among the agro-pastoralists, but actually increasing when wasting decreases with less poverty (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.

< figure 3 near here >

Internally Displaced People (IDPs) and Migrants.

Wasting prevalences among IDPs tend to follow those of the surrounding population, but usually were significantly higher (within country and pooled), see table 2B: the average increase was 3 ppts overall. Surveys of IDP populations were mainly in Somalia (n=25) and Uganda (n=57), see table 1B. In Somalia (see table 2B) the prevalence was raised by 4 ppts ($p<0.05$, compared to agriculturalists), less compared to the average. In Uganda the increase was smaller and not significant (table 2B). Malnutrition is thus somewhat increased in IDPs, but less than, for example, by year or livelihood differences. In the 30 surveys of returnee groups (i.e. previously displaced) in the dataset, no significant difference in wasting prevalence was seen compared to 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 was similar to that of pastoralists (see tables 2B and 3), raised compared to agro-pastoralists. These populations are of concern because of growing dependence on food distributions and poor prospects of resuming their livelihood due to lack of viable livestock herds.

Season and year.

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 ppts in 2000, 2.7 ppts in 2003, and 2.1 ppts in 2006. Prevalences by country and year (adjusted for season and livelihood) are shown in table 4. In Kenya, Somalia, S Sudan, and Ethiopia (Afar and Somali regions) the populations are mainly in arid/semi-arid environments, substantially livestock-dependent; in Ethiopia (other regions) and Uganda livelihood is more agricultural. The factor-of-two difference in the average prevalences between these two (about 20% cf 10%) probably reflects this difference in livelihood. Further, the arid/semi-arid areas tend to have greater variation between years – e.g. 9 ppts in Kenya cf 3 ppts in Ethiopia (other).

< table 4 near here >

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, for lack of data. The data accumulated here provide an unusual opportunity to quantify seasonality of malnutrition, although (again) the non-random 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 ppts on average, for the hungry season. However this is not consistent across countries (table 2B). The relatively small size of the effect may be due to uncertainties in defining 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 (although the sampled population itself may differ within the area). Somali region in Ethiopia has 53 surveys, and Rift Valley in Kenya has 64, 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 Somali Region, Ethiopia, is shown in figure 4A. While fluctuations do appear, these are not always aligned as expected, such as increases in the hungry season. Pooling the data across the pastoral regions (Kenya, Somalia, S Sudan, and Ethiopia (Afar and Somali)) gives the pattern shown in figure 4B. This shows a similar picture, with the hungry season the worst in 2000 and 2002, which were the highest means recorded, at greater than 25% prevalence; in other years peaks were not necessarily in the hungry season.

< figures 4 A and B near here >

The size of the fluctuations within years by season is typically around 5 ppts (best to worst season), although this rose to as high as 10 ppts in 2002 (figure 4B, seasons 7-9). 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 ppts or so (see tables 2B and 4).

Distinguishing seasonal fluctuations from other changes.

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 ppts, and may be as much as 10 ppts when conditions deteriorate. This is observed over (roughly) four month periods, as displayed in figures 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 Rift Valley Province (RVP, Kenya, n=64, 76% pastoralist), Somali region (Ethiopia, n=53, 43% of surveys defined as pastoralist; however this is mainly a pastoralist area) and Oromia region (Ethiopia, n=97, 35% pastoralist: mainly agricultural). Prevalences are plotted against total months from January 2000, in figure 5.

< figure 5 near here >

These plots readily identify broad patterns, in retrospect. For instance, early 2000 had very high wasting prevalences in both Somali and Rift Valley Province (RVP). Peaks of wasting are recorded for early 2001 (minor in RVP), 2002 and 2003 in both these areas, and a further peak in early 2004 in RVP. These peaks reach 30% wasting or higher, and in good years the prevalence can fall to 10-15%. In contrast, Oromia seldom reached 20% wasting, and usually fluctuated by about 5 ppts around a mean of 10%. Note that we get more fluctuation here, compared with the averages given in figure 4B.

The prevalences in Somali Region (Ethiopia) and Rift Valley Province (Kenya) appear to be around 10% at best, and reach 30 or 40% in bad years. The peaks of wasting tend to be in the second quarter of the year, corresponding to the period before the rains in Ethiopia, but less clearly so in Rift Valley. In Oromia the wasting prevalences are consistently lower, fluctuating between about 7 and 15%.

DISCUSSION.

The results from the compiled small scale surveys show, on average, that pastoralists typically have about 17% wasting. The agriculturalists and mixed (agro-pastoralists) are around 10% wasting. This is supported by the results derived from DHS surveys. An analytical issue here is to decide what is typical and what represents deterioration – moreover the important question is what signals show that intervention should be triggered – and these signals may be different for different populations.

Pastoralists. Interpretation of survey results may be seen in context from time series plots such as in figure 5. For Ethiopia-Somali Region, and Kenya-Rift Valley Province – both mainly pastoralist – the size of the fluctuations is large and it seems reasonable to conclude that periods with relatively low nutritional stress typically have prevalences of 10-15%; times of high stress tend to be 25% or above. Thus a first inference is that around 25% wasting represents a problem to be addressed, in these populations. Moreover, simply plotting new survey results as part of a time series such as this may be valuable in facilitating interpretation.

However, the timing and the rate of change are also relevant. In most instances the peaks are in the first part of the year, which is generally in the dry season and expected; nonetheless these data confirm the timing. Further, they suggest that wasting prevalences that reach only 20% at this time are seldom followed by higher rates; and conversely that when there are problems the prevalences at this time are greater than 25%, and often up to 30 or 40%. This suggests surveys should be deliberately timed for the early part of the year; and more than one survey, in adjacent areas perhaps, are useful to triangulate.

Results analyzed by season indicated that the patterns were only somewhat regular by season, moreover the size of the seasonal effects, of about 5 ppts in normal years, were not such as to obscure the considerably larger shifts seen in years of deteriorating nutrition.

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 in figure 5 C (Oromia) provide a useful illustration. The interpretation is not that Oromia had less nutritional problems, because we know the growth patterns of pastoralist and non-pastoralist children differ significantly. Thus if we had estimates of underweight or stunting the impression from this comparison would be very different (as indeed was found in southern Africa, where the effects of the 2000-1 droughts were largely on underweight and stunting, while wasting hardly altered: Mason et al, 2005).

In Oromia (as the example here), it seems likely that when 20% wasting is reached in several surveys (e.g. in 2005) this indicates a problem, and at that time serious food shortages from drought were indeed a concern in southern Ethiopia (FAO, 2006). It appears from such observations that an increasing trend in wasting in an agricultural population (e.g. Oromia) reaching 15% prevalence should be regarded as implying a

similar need for intervention as a trend reaching 25% in pastoralists in (e.g.) Somali Region.

Wasting provides only a partial indication of malnutrition. The stunting levels – as seen only from the DHS data – are similar between pastoralists and agriculturalists, in some cases higher in the latter; moreover, as wasting decreases with better SES (in pastoralists in the Kenya sample) stunting remains similar or possibly increases (Somalis in NE Kenya). The Oromo in Ethiopia generally have more stunting than the Somalis – in line with the divergent growth pattern shown earlier. Thus if the time series in figure 5 were of wt/age, or included stunting, the picture would look much different, and Oromia would seem similar to Somali Region and Rift Valley Province.

The different growth pattern of pastoralists and agriculturalists is related to very different diets – cereals are important for children of agriculturalists, while pastoralists have significant intakes of milk (and often cow's blood). When food is scarce, the milk/blood diet is likely to provide low energy intake, but still relatively high protein, iron, calcium, and other micronutrients – which will favour continued height growth rather than soft tissue. The opposite applies for agriculturalists – energy may be reduced, but diet quality (protein and micronutrients) fall more (from already a less-good level): this will favour stunting but less wasting. This is in line with observation, including the greater extent of fluctuation in the pastoralist groups as seen in figure 5.

Wasting prevalences are a proxy for malnutrition, giving a partial picture, and are used in this context because no others are available, as age is not determined with any accuracy. The aim is to reflect both food and health crises, and risks to child health, development and survival. However, if wasting was telling the full story, and pastoralist children are indeed more malnourished, then they would be more stunted, which they are not. Given the difference in growth patterns by livelihood, *different criteria are needed in evaluating wasting prevalences*. These criteria would be less different if stunting (or underweight) were available routinely and could be used.

Summarizing this line of argument goes as follows. Pastoralist and agriculturalist children have different growth patterns, related to different diets for mothers and children. In lean times, pastoralist children reduce energy intake but continue to eat some milk/blood (with protein and iron, calcium etc), so they reduce soft tissue more than length – becoming thin but not greatly increasing stunting. Agricultural children reduce energy intake (perhaps less than pastoralists) but do not maintain intake, already lower, of growth factors for length (animal products) – they become thin but less so, and more stunted. Related to this, pastoralists show greater fluctuations in wasting, as well as higher underlying levels. (In fact, pastoralists may be better protected for some developmental aspects by the better micronutrient intake.) Since we only have wasting for normal monitoring (but really need stunting too) wasting is a proxy; therefore we need different interpretation criteria for agriculturalists vs pastoralists.

To compare inferences of wasting levels between populations we need data on either causal factors (food security, health) or risks to be averted (destitution, mortality,

developmental retardation, ill-health and other disability). The only data intermittently available from these surveys is mortality, which will be described in a future paper. From the descriptive results themselves – which stem from the largest compilation of such survey data ever assembled as far as we know – rules suggested are as follows, for vulnerable populations in the GHA:

- among *pastoralist* child populations, wasting prevalences of up to 15% or 20% are not indicative of unusual conditions, but above 25% is;
- among *agricultural* (or mixed agro-pastoralist) populations wasting prevalences of up to 10% are not uncommon, although around 5% is more normal; above 15% does suggest the need for concern and possible intervention;
- wasting prevalences can increase rapidly, particularly in the dry season(s); any results above 25% seem to have been replicable (and replication should always be attempted) and indicative of potential crisis.

Displacement and migration. The survey data available suggest that internally displaced populations are only marginally more malnourished than the surrounding population. Returnee populations were not more malnourished. Groups that had migrated to small towns in N Kenya – most in Turkana in the surveys – were similar in wasting prevalences to the pastoralist populations outside towns, but of particular concern as becoming dependent on food distributions and without viable livestock herds to allow re-establishment of normal livelihoods.

Implications for timely warning for interventions to mitigate malnutrition. Area-level surveys provide credible results that can be interpreted with more confidence when set in the context of the fluctuations observed over time, such as in figure 5. These can be readily updated. The interpretation should be specific to livelihood groups, and/or assessed separately (e.g. plotted) for limited areas. Pastoralists show larger fluctuations than others, from a somewhat higher baseline. For example, among pastoralists wasting levels of 10-15% are usual in non-emergency times, and these can rise rapidly to 25% or more. In contrast, populations more dependent on crops (agro-pastoralists and agriculturalists) have prevalences of 5-10% in non-emergency times, rising to 15% when there is stress due to drought or other factors. These differential levels for interpreting prevalences by livelihood group are in line with very different growth patterns in height and weight in infants and young children, particularly between those largely dependent on livestock, and others.

The timing of peaks of prevalence helps the interpretation. As expected, these occur during the dry season, in the first half of the year in the areas studied. Thus when there is concern surveys should be started during this period, and prevalences increasing to above (for example) 20% in pastoralists, and 15% in agro-pastoralists or agriculturalists taken as a warning that intervention may be urgently needed. Prevalences should come down to below 20 or 15% (depending on livelihood group) by the latter part of the year, and if they do not this is a sign that conditions may be even worse in the following dry season.

While the current practice of multiple small-scale surveys (sample sizes around 1000) provides useful information, a move towards more regular reporting could substitute for some of the surveys. For example, reporting from clinics, and regular surveys of sentinel areas such as undertaken by the arid and semi-arid lands project (ASAL) in N 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.

A key conclusion here is that interpretation of survey estimates of wasting, when seen in the context of historical values and viewed as specific to different livelihood groups, can provide important timely warning of the need for intervention to mitigate developing nutritional crises.

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List of Figures and Tables

Table 1. Distribution of surveys. A. By country and season. B. Distribution of surveys by country and livelihood.

A.

		Kenya	Somalia	Sudan	Uganda	Eritrea	Eth-other	Eth-Af-Som	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
Post-Hunger 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 %	Unadj	20.5 (159)	15.9 (105)	20.9 (142)	9.3 (93)	15.8 (11)	9.6 (310)	19.1 (75)	14.9 (895)
	Adj [1]	19.2 a	15.3 a b	22.7 a b	8.4 b	14.4 b	9.9 b	18.5 a	

Note: (last row) a = significant ($p < 0.05$) difference from Uganda; b = significant ($p < 0.05$) difference from Kenya

[1] Adjusted for year, season, drought

B.

		Kenya	Somalia	Sudan	Uganda	Eritrea	Eth-other	Eth-Af-Som	Total
Pastoralist	N	123	50		10		39	26	248
	%	77.4	47.6		10.2		12.6	34.2	27.5
Agro-pastoralist	N	15	16		14		88	24	156
	%	9.4	15.2		14.3		28.4	31.6	17.3
Riverine agriculture	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
Displaced (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

Table 2A Associations of livelihood, drought, season, year and country with wasting prevalences: B is regression coefficient (OLS).

		B
	(Constant)	6.02 ***
Livelihood: pastoralist	DPAST2	1.18
Livelihood: agr-past	DAGPAST2	-1.37 *
Livelihood: urban	DURBAN2	1.99
IDPs	DIDP22	1.49
Drought reported	D_DR2	1.36
Hungry season	D_HUNG2 ***	1.94 ***
Moderate season	D_MOD2 **	1.46 **
2000	D_Y00 ***	4.66 ***
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 *
Kenya	D_KENYA ***	10.30 ***
Somalia	D_SOMALI ***	5.94 ***
Sudan	D_SUDAN ***	12.34 ***
Ethiopia: Afar+Somali	D_ETHAS ***	9.15 ***
Ethiopia: Amhara+ Oromia+SNNPR+Tigray	D_ETHOTH	1.01
Eritrea	D_ERITRE	2.90
N	877	
Adj R sq	0.425	

* P<0.05, ** P<0.01, *** P<=0.001

Table 2 B Associations of livelihood, drought, season and year with wasting prevalences.

		All	Kenya[1]	Somalia	Sudan	Eth Afar+Som	Ethiopia all	Uganda
	Constant	7.401***	9.717***	18.765***	16.047	9.322**	7.697***	5.373*
Livelihood: pastoralist	DPAST2	6.701***	7.609***	3.118	NA	1.154	2.433**	10.156***
Livelihood: agr-past	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
IDPs	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
Hungry 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: S Sudan	DLSUDAN	10.870***	-1.934	NA	NA	NA	NA	NA
	N	875	159	89	141	71	382	93
	Adj Rsq	0.296	0.287	0.289	0.174	0.206	0.149	0.496

[1] Agro-past excluded group as no agriculturalists in sample.

Note: Excluded categories: for livelihood, agriculture (except Kenya, see above); for season, post-harvest; for year, 2004 (best year); livelihoods not known for Sudan, so all Sudan coded as separate livelihood (DLSUDAN); no seasons recorded for Uganda, all coded as moderate (for model 'all'). Dependent variable wasting % (AVEGAM2). All includes Eritrea (n=11). Dataset: SEMmerge3_9F2.sav (select possdup2=0).

P <= 0.05*, 0.01**, 0.001***. Ns: a datapoint is a survey result, typically prevalence in around 900 children.

Table 3. Adjusted mean wasting %s by livelihood and country

Livelihood	Kenya	Somalia	Sudan	Eth-AS	Eth-Other	Uganda	All (adj 1)	All (adj 2)
Pastoralist	21.0 (123)	16.7 (46)	--	18.8 (26)	8.4 (39)	16.8 (10)	15.9 (244)	17.2 (244)
Agro-pastoralist	13.3 (15)	14.0 (16)	--	16.9 (24)	9.3 (88)	6.7 (14)	13.4 (157)	11.1 (157)
Agriculturalist	--	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	--	--	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 (unadj)	20.5 (159)	16.1 (89)	20.9 (142)	18.6 (71)	9.6 (310)	9.3 (93)	14.8 (864)	14.8 (864)

All: 1. Adjusted for country, season, year. 2. Adjusted for season, year.
Note: location in Sudan treated as livelihood as no other information; see 'Methods'.
IDP = Internally displaced population.

Table 4. Adjusted mean wasting %s by country and year.

	Kenya	Somalia	Sudan	Eth-AS	Eth-Other	Uganda	Eritrea	All (adj 1)	All (adj 2)
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 (unadj)	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)

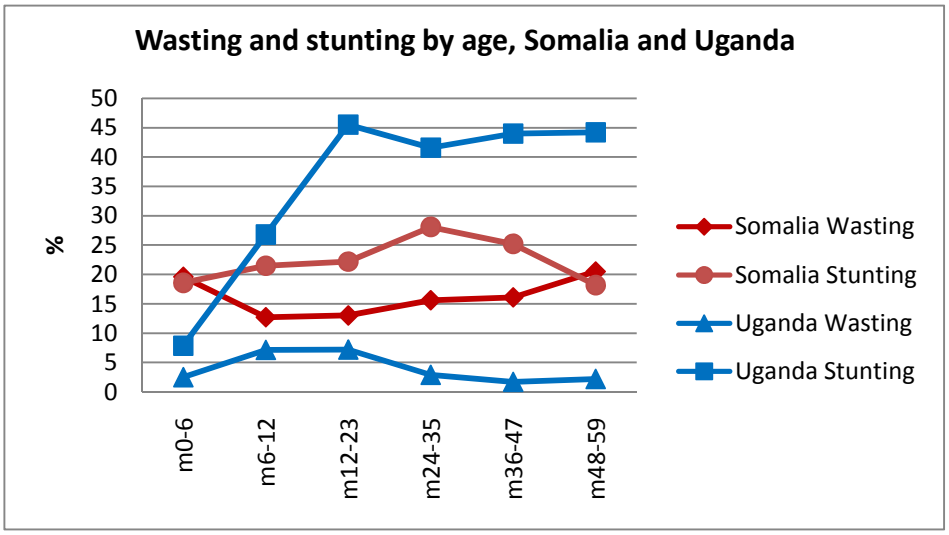
All: 1. Adjusted for country, livelihood, and season. 2. Adjusted for livelihood and season.

Figure 1. Arid and semi-arid land areas, from which surveys compiled 2000-2006 for this study.

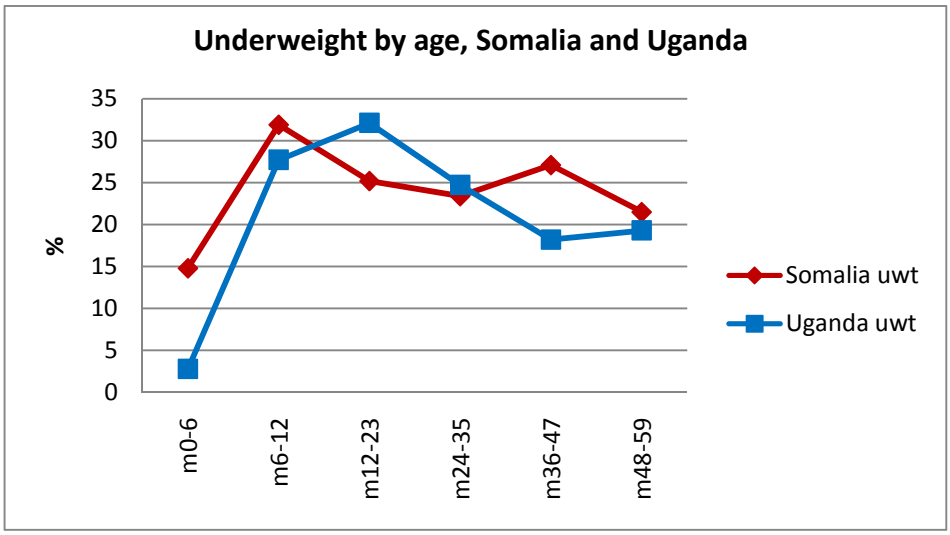
Areas studied here shaded gray.
Areas for which data are presented in figure 5 are indicated: Rift Valley Province in Kenya, and Somali and Oromia Regions in Ethiopia.

Figure 2. Growth patterns (0-60 months) in Somalia (mainly pastoralist) and Uganda (mainly agricultural), from national DHS and MICS surveys.

A. Stunting and wasting.



B. Underweight



Sources
Uganda, Measure DHS 2000:
http://www.measuredhs.com/pubs/pdf/FR128/10Chapter10.pdf
Somalia: UNICEF/MICS, 1999:
http://www.childinfo.org/MICS2/newreports/somalia/somaliatables.PDF

Figure 3. Prevalences of wasting and stunting by livelihood group – pastoralist (P) and agricultural (A) groups – and SES, in Somali and Oromia Regions (Ethiopia) and Rift Valley Province (Kenya)

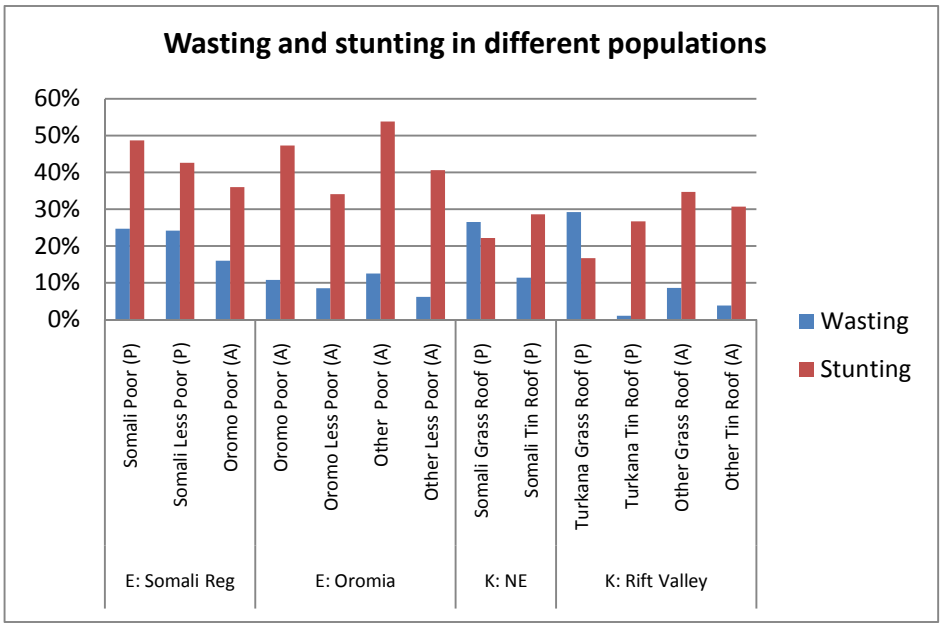
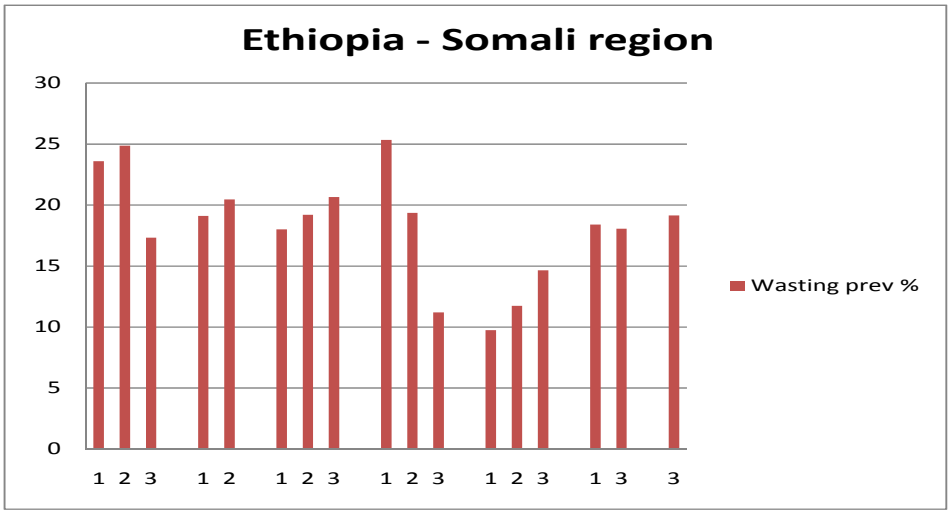


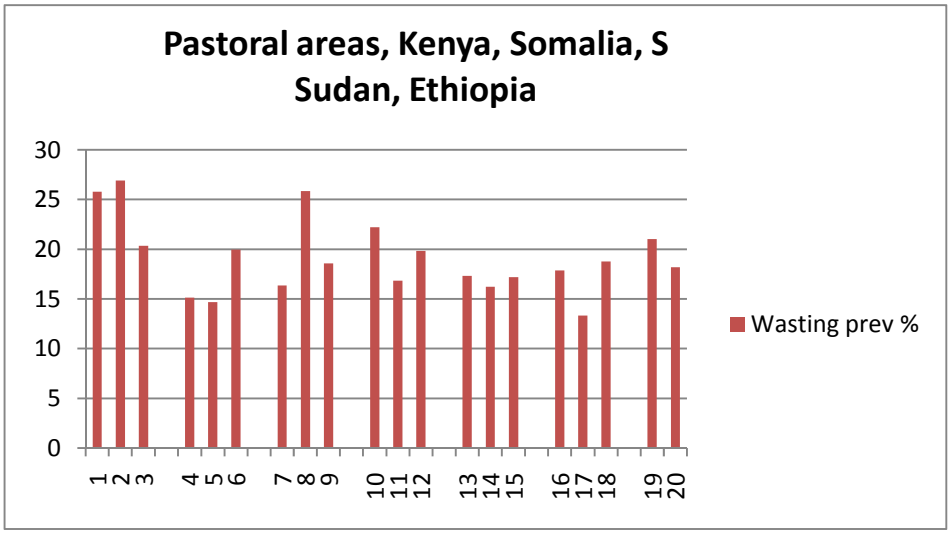
Figure 4. Prevalences of wasting by season.

A. Somali region, Ethiopia, 2000-6.



Seasons (each year, 2000-6): 1 – moderate; 2 – hunger; 3 – post-harvest.

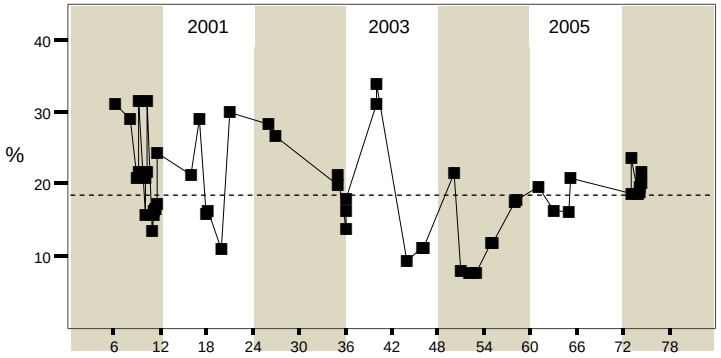
B. Pastoral areas in the region, 2000-6.



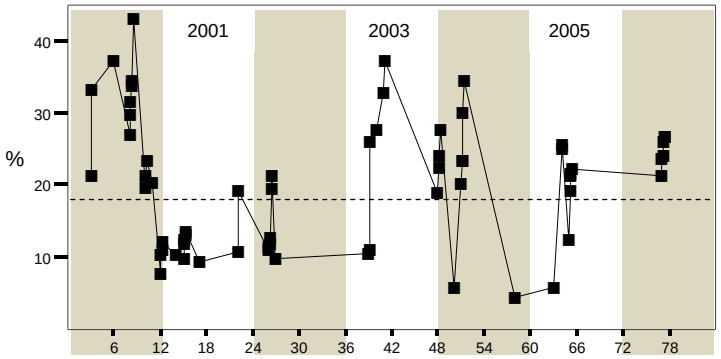
Areas: surveys from Kenya (NE, E and Rift Valley Provinces); Somalia (all); S Sudan (Bhar el Ghazal, Jonglei, Upper Nile, Equatoria); Ethiopia (Afar and Somali Regions).
Seasons: as above, 2000-2006: e.g. 1, 4, 7 moderate; 1-3, 2000, 4-6, 2001; etc.

Figure 5. Prevalences of wasting (each point is a survey result)

A. Ethiopia, Somali Region (mainly pastoral).



B. Kenya, Rift Valley Province (mainly pastoral)



C. Ethiopia, Oromia Region (mainly agricultural)