

A Situation Analysis of the Nutrition Sector in Ethiopia

A report to UNICEF^a and EU
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Summaries

Section 1. Introduction

The Ethiopian Government in introducing the 2013-5 National Nutrition Programme stated that ‘... attainment of positive nutrition outcomes will be achieved through evidence based programming ...’. The EU with UNICEF has sponsored a situation analysis of the nutrition sector, to assess the evidence to be ‘... used to develop an EU+ Joint Nutrition Strategy and Joint Action Framework for Ethiopia ...’; the present report contracted by UNICEF aims to complement current capacity in Ethiopia to complete this task. Preliminary results were presented in a workshop in Addis in March 2015.

This analysis of the nutrition sector covers three tasks: nutrition trend, equity, and causal analysis (section 2 of this report); mapping of nutrition interventions (section 3); and analysis of gaps and opportunities (section 4). Four risk and programme areas (related to child malnutrition) are the focus: poor water supply and sanitation – WASH; infant and young child feeding practices (IYCF) – CBN; poverty—PSNP; and access to health services.

We want to highlight here that are probably analyzing an incredible success story. The recent sustained progress in Ethiopia documented here and elsewhere has contributed to rapid improvement in nutritional status; and (as we can show) improving living standards, education, and direct nutrition interventions (especially community-based) have added their contribution to this. If current economic development (and the policies supporting this) continue, extending and improving current programmes – as we propose here in section 4 – could lead to the near-elimination of child malnutrition within 20 years or so.

Section 2. Nutrition situation analysis for guiding decisions on interventions

Section 2a. Methods

Data were used from four DHS surveys (2000-2014), with focus on the larger ones of 2000 and 2011. Data on resource flows from donors were from OECD/DAC, and from a study on nutrition stakeholder mapping, 2013-15. Weighing program and evaluation data were used. Data errors from DHS surveys included substantial age heaping and length mismeasurement of children standing when they should have been lying and vice versa; these differed between surveys affecting comparability and were taken into account, for length mismeasurement by eliminating wrong cases; sensitivity analyses were done. A total of 10.8% of the DHS-derived sample was lost because of these errors. Samples from DHS surveys were comparable from similarity of long term factors expected to be stable, such as respondents’ heights. Effects on results of seasonality and year-to-year production changes from drought were considered. Other details of methods, such as geocoding, mapping, and resource estimates, are given in the respective sections.

Section 2b. Trends and differentials in nutritional status

The national rate of improvement in stunting was estimated as 1.5 ppts/year, 2000-2011, likely continuing to 2014. This is presently the fastest in Africa, and may be the fastest national African level estimated at any recent time. The improvement was consistent across the country, except for the lowland pastoral areas (Affar and Somali) recently affected by drought. Actual prevalences were not much different between livelihood groups (pastoralist, agricultural, agro-pastoralist).

Distinguishing groups by important determinants of child malnutrition (e.g. maternal education, absolute (no-assets) poverty), almost all the population improved at about the same rate – e.g. the poorest groups in 2000 and 2011 improved by the same difference in prevalence. Income, consumption and expenditure grew rapidly – income by 10% or more per year – and this accounted for much of the change. However, additional change due to, for instance, moving out of absolute poverty or increased proportions educated, can be seen. Child nutritional status is the same across all but the richest income quintile at any one time; the stunting – wealth lines shift down with time but remain largely flat. There is evidence that the CBN contributed to this improvement for the 30-50% participant children – indeed the 2008-15 weighing data appear to show that malnutrition is almost eliminated for these children.

Anemia in women is much different by region – more than double the national average for example in Tigray and Affar. Anemia is like child malnutrition in relation to wealth, only improving in the richest quintile. Moreover it appears to have improved substantially for those areas with already relatively low levels, but hardly at all in those regions most affected in the north. On the other hand, women's low body weight (for height, i.e thinness, measured by BMI) – again relatively unaffected by wealth – has changed hardly at all in the last 15 years, and is at almost double the prevalence in Tigray and Affar. The reason for this lack of change, strikingly different to that in children, is not estimable from the data.

The picture viewed in the longer term fits very well into expectations from the demographic transition now well under way in Ethiopia (IMR has plunged, and TFR is now nearly 4). Child malnutrition prevalences were probably stable until around 20 years ago, then started an accelerating fall, of which Ethiopia is now in the middle. If policies such as those for economic growth, education, and nutrition interventions continue, an end to stunting can be foreseen within the next 20 years.

Section 2c. Risk factors: correlates of malnutrition as a basis for extending interventions to further improve child nutrition.

Four risk areas were analysed, based in part on their connection to important programmes: water supply and sanitation; poverty; infant and young child feeding practices; and access to healthservices.

Poor water supply and sanitation were risks for child stunting, poor sanitation more so in the <24 month age group, and these associations were seen across most regions. Although these were independent effects, they were importantly modified by (i.e. interacted with) SES, such as

maternal education, in an equity-negative direction, such that the higher SES group would be expected to benefit more from improved water or sanitation. For water supply in particular, this suggests that an educational component should be included with water supply improvement interventions so that the growth of children in worse-off households benefits. Unfortunately, further analysis shows that child stunting does not increase until the quality of water improves to the level of piped – those with well water are no better grown; thus water for about 75% of households needs to be improved – this is concerning, but worth knowing.

Within poverty groups no additional risk factors were identified (not very surprising since poverty definitions include many of these likely risk factors). However, the impact of improved SES, like education, can be extracted from within the overriding trend of poverty reduction.

Improving non-optimal infant and young child feeding (IYCF) practices at the appropriate ages provides a major opportunity for enhancing child growth, moreover one that is (unusually) equity-positive – the children worse-off SES households would benefit more. These cover breastfeeding, introduction of (semi-) solid foods, meal frequency, and dietary diversity. Of these, dietary diversity is particularly poor throughout Ethiopia, and would benefit from a broad approach, including agriculture, education, and other sectors (this is not to be taken to advocate home gardens, for which there is general evidence for scant impact). The directly relevant programme intervention is through the kebele workers (HDA) in the CBN, from whom messages more focused to appropriate ages could be effective; this has implications for training, supervision, etc.

Access to health services was assessed in relation to children above and below 24 months, although only feasible with indirect indicators (home delivery, ante-natal care; immunization, treatment of diarrhea). While there is no doubt that access to health services, and the success of extending the HEP, is of central importance for child growth, development and health, the associations with these factors in the data were limited (although in the expected directions), and seen mostly in the younger children. The policy implications are clear even without this, and this was not pursued further.

The associations of child stunting with risk factors was then used to define areas of risk, leading to the maps in the next section, and to suggesting gaps and opportunities in section 4.

Section 3. Needs relative to programmes

Section 3a. Mapping of nutrition programme need at zone level.

To the DHS merged database geocodes were added, and this allowed both further merging with nutrition programme data, and with geographical definition at the level of administrative zone. There are 70+ zones compared to 12 regions, and the zone was considered a reasonable aggregation level, compromising between programme policy needs and stretching the data perhaps a bit further than it should (but we used categories of tertiles to mitigate this). Maps were developed combining three dimensions: child malnutrition prevalences (using underweight here to ensure that areas with high wasting were shown as high risk); extent of risk factor (e.g. of poor

water supply); and programme presence, derived from the FMoH/REACH database, merged in. Maps get confusing with overlapping three dimensions, so the latter two were combined, as for example ‘high risk-low programme presence, medium risk-medium programme presence’ and so on.

We suggest that these maps are an important way in which the results of these analyses should be digested. They cover the four risk-programme areas, and suggest targeting priorities in geographical terms, as well indicating severity of risk and outcome (stunting).

Section 3b. Resources.

Quantitative estimates were made with respect to donor resource disbursements for 2012 and 2013, from DAC data, by sector and sub-sector. A total of 3065 project in 2013 received donor funds, totaling \$3.67 billion. Health was the largest sector, with about \$650 million; within this nutrition was categorized as a sub-sector, with \$64 million. Projects in other sectors were examined for their relevance to nutrition; less than 10% of agricultural projects were specific to nutrition, and (by different estimates) 10-30% likely to have significant indirect nutrition benefit. WASH and health were similar. Population and reproductive health – mainly for HIV/AIDS – had \$300-400 million disbursed annually, arguably relevant to nutrition but not assessed as such.

The direct nutrition funding (\$64 million) while limited could be enough if focused through CBN to have a nutrition impact on a significant number of children judged by the usual norm of around \$10/household/year for impact – and indeed may already have done so. However, it is unclear how or whether other sectors are substantively orienting their resources towards nutrition impact (avoiding cosmetic addition of nutrition components). Mainstream development already appears to be driving much of nutrition improvement, and this could possibly be further enhanced by deliberately focusing non-nutrition (and non-health) resources on this objective.

Section 3c. Qualitative and field studies

Field visits to selected woredas aimed to gain information on operational programmes and how these met needs. The programmes reviewed were along the same lines as other analyses – WASH, Alive and Thrive (A&T), CBN and GMP, the Agricultural Growth Programme, ‘ENGINE’ (Empowering New Generations in Improved Nutrition and Economic opportunities), and PSNP (Productive Safety Net Programme).

Those programmes aimed directly at children’s nutrition (A&T, CBN, ENGINE) had shown successful implementation although with resources seemingly only just in the range expected to bring significant impact, and increased capacity, resources, and extension to more of the population would be expected to enhance the impact. The programme content of these was perhaps more adequate than the resourcing and capacity. Nonetheless improved training materials (including e.g. more age-specific focus for IYCF) and supervision present opportunities that should be taken. Integration of frontline worker activities between sectors (e.g. health/nutrition with agriculture) was seen to be locally viable, and needs sectoral encouragement and resources. Observations have been integrated into interpretation of the quantitative findings.

Section 4. Gaps and Opportunities.

Two broad types of opportunity present themselves: extending, reinforcing, and targeting the large programmes that directly impact food consumption and nutrition (WASH, CBN, PSNP, HEP); and taking advantage of, or mitigating, the effect modifiers (interactions) that are commonly found likely to affect these programmes' impact on child nutrition. Whole new programmes are not suggested by the data, as is to be expected when there has been vigorous and broad government and donor action to address the range of poverty-related issues in Ethiopia.

Gaps to be filled are represented in the maps in the previous section. These indicate that large areas of the country, with high prevalences of risk factors and malnutrition, are in need of programmes. While there is some good targeting, most bears little relation to need. This could be a priority for review and for decisions on use of additional resources (not primarily shifting resources – the better-served areas probably still need their programmes). This applies not only to nutrition (CBN), but to WASH, PSNP, and even HEP.

Second, many interventions – most of those examined in fact – have more impact on the less-poor than the poorest. In some cases, for example water supply, this suggests that additional steps are needed, as water supply is improved, to change behaviours so that there is more benefit to child health and nutrition. In others, the programme design itself may need to find ways to better involve the poorest. In the case of improving IYCF, this relation is usefully equity-positive, and of itself is expected to benefit the poorest.

Situation Analysis of the Nutrition Sector in Ethiopia.

1. Introduction.

As stated in the preamble to the 2013-5 National Nutrition Programme (NNP): The Ethiopian Government “found the high malnutrition rates reported in EDHS and various surveys over the years completely unacceptable. We shall work through enhanced strategic partnerships to prioritize the elimination of malnutrition from Ethiopia as one of the most viable strategies for achieving the Growth and Transformation Plan and the Millennium Development Goals. Attainment of positive nutrition outcomes will be achieved through evidence based programming and responsiveness and the promotion of accountability towards these results by each Ministry here undersigned^b”.¹

The EU in 2014 put forward a roadmap² for joint nutrition programming for EU and partners with GoE, in support of the NNP. Part of this involved a situation analysis, which UNICEF agreed to implement on behalf of EU, (UNICEF and DfID being the development partners on the National Nutrition Coordinating Body). The overall intent of this, in sum, was to propose steps that could be followed in support of an EU+ Joint Programming on Nutrition, and an analysis of the nutrition situation was seen as one key component. UNICEF requested Tulane University^c to undertake a situation analysis of the nutrition sector^d, with three main tasks: nutrition trend, equity, and causal analysis; mapping of nutrition interventions; and analysis of gaps and opportunities. The report here is the result. Preliminary results were presented in a workshop in Addis in March 2015.

The tasks fit together to provide the basis of situation analysis as illustrated in figure 1.1. The trends and correlational analyses are in section 2. The mapping, assessment of programmes and resources are in section 3; and the Gaps and Opportunities in section 4 focuses on the four main risks and programmes we examined, with respect to stunting and wasting (summarized in the combined maps as underweight).

In the second section (2a) *methods* are described in some detail, enough for the analyses to be repeated and extended. It is recognized that this may not be of interest to all readers; an alternative will be to put much of this section into ‘Supplementary materials’, see below. The results of the *trends* and then the *correlational analyses* are given in sections 2b and 2c respectively. Here, sufficient detail is intended to justify the conclusions reached, and additional materials are again in ‘Supplementary materials’. The overall intent is to be evidence-based, and this is the evidence from the data used here – based on but not confined to four EDHSs.

^b Ministers of: Health, Education, Industry, Water and Energy, Trade, Agriculture, Labour and Social Affairs, Finance and Economic Development, Women, Children, and Youth Affairs.

^c Tulane University, School of Public Health and Tropical Medicine, Department of Community Health and Behavioral Sciences, New Orleans, USA. Principal Investigator, Prof John B Mason.

^d Contract number 43173993, Feb-Nov 2015.

In the third section (3a) results are displayed as a series of *maps*. These are in the four risk and programme areas (related to child malnutrition) that we came to focus on: poor water supply and sanitation – WASH; infant and young child feeding practices (IYCF) – CBN; poverty—PSNP; and access to health services. The map sections for each of these are meant to be self-standing and can be extracted for the particular programme. The programme data here depended on integrating and using FMOH/REACH data on programmes³. The next part (3b) contains our assessment of donor *resource* availabilities. Since little data was available from Ethiopia (and there was very limited response to a questionnaire sent out by UNICEF) we relied on the donors' own reporting system to OECD – Development Assistance Committee (DAC). This was analysed in terms of nutrition-'specific' and '-sensitive' interventions. In the third part of section 3 (3c) results and conclusions from in-depth review of selected large-scale programmes (based on risk and programme areas of interest) and *field visits* are given, with much more material again available as 'Supplementary material'.

Finally, in section 4, these results are interpreted in terms of programmatic *gaps* that can be filled, which are then *opportunities*. This focuses on the interventions with direct nutrition effects – WASH, CBN, PSNP, and health services.

The designation 'Supplementary material' is used for a number of pieces that are too detailed for the report itself but need to be retained. The material goes on the web, and thus can be quite extensive if need be. This is a common practice in scientific publications. We are presently putting this on our website^e, and it can be transferred to UNICEF (or elsewhere) when convenient.

A present gap that we acknowledge is the limited inclusion of background material, due to prioritizing analysis and interpretation. We have a large bibliography that can be listed in a later version, and aim to have a brief review to give context.

We should stress that we are not repeating work by others on the DHS data – by IFPRI, Groundworks, and others. We are not aiming to build large causal models, but rather to investigate risk factors that can be addressed by (mainly) direct interventions. We think that this has addressed much of the intent in the original EU-UNICEF thinking – if at a less ambitious level, perhaps more operational.

* * *

It is hard to avoid – even in this introduction, before we have presented any results – recognizing that we are analyzing what looks like an incredible success story. The recent sustained progress in Ethiopia documented here and elsewhere (e.g.⁴) has contributed to rapid improvement in nutritional status; and (as we can show) improving living standards, education, and direct nutrition interventions (especially community-based) have contributed to this.

On a more parochial note, a couple of points concerning information should be stressed. Two extremely useful nutrition databases exist, complementary to each other. The FMOH NNP Monitoring Tool containing the growth monitoring data, and much else, should continue to give

^e <http://tulane.edu/publichealth/internut/>

easily understood updates. The figure we use from this in section 2 and repeated here (figure 1.2) is dramatic, and while it must be checked against other data, appears to show that for children in the CBN the problem of malnutrition is almost solved.

The second is the database constructed and used for this project, which is unusually powerful. It contains the data from four DHS surveys, with geocodes added at the zone level, with data on programme activities at that level, plus ecozone classification; and other geocoded data can be added. The results are not inconsistent with figure 1.2, but this cannot be directly checked.

* * *

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Figure 1.1 The components of situation analysis.

Components of situation analysis

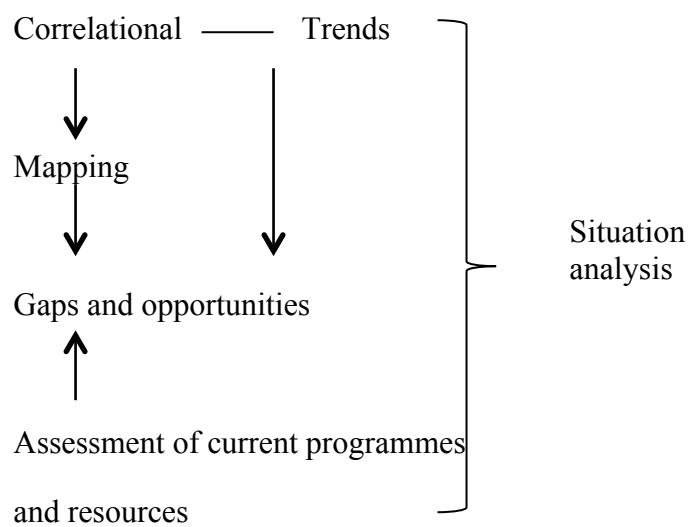
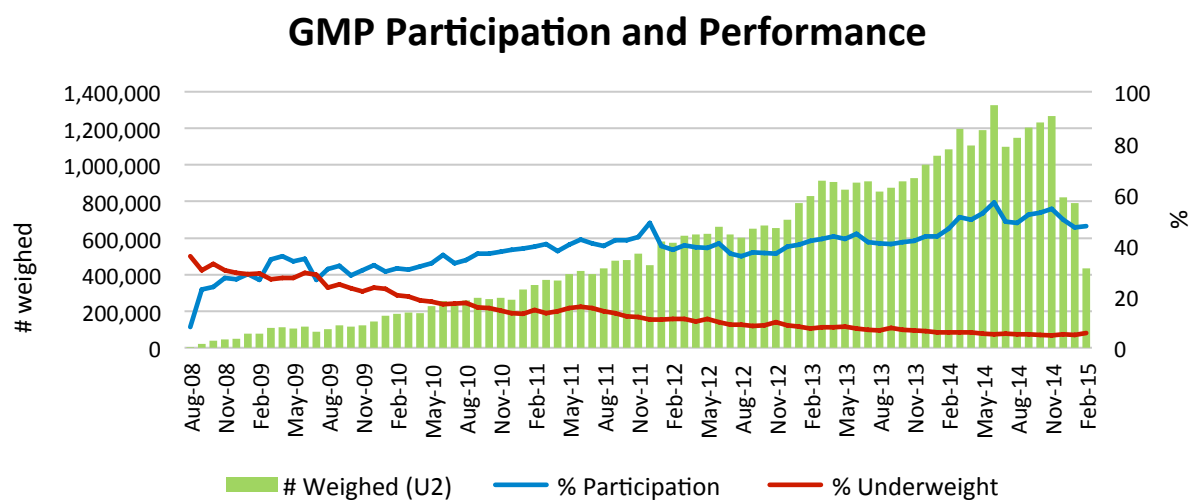


Figure 1.2 Reduction in child malnutrition (underweight) and increased participation in CBN, 2008-15.



Source: UNICEF nutrition database

2. Nutrition analysis for guiding decisions on interventions

2.A Methods

Summary

Data were used from four DHS surveys (2000-2014), with focus on the larger ones of 2000 and 2011. Data on resource flows from donors were from OECD/DAC, and from a study on nutrition stakeholder mapping, 2013-15. Weighing program and evaluation data were used. Data errors from DHS surveys included substantial age heaping and length mismeasurement of children standing when they should have been lying and vice versa; these differed between surveys affecting comparability and were taken into account, for length mismeasurement by eliminating wrong cases; sensitivity analyses were done. A total of 10.8% of the DHS-derived sample was lost because of these errors. Samples from DHS surveys were comparable from similarity of long term factors expected to be stable, such as respondents' heights. Effects on results of seasonality and year-to-year production changes from drought were considered. Other details of methods, such as geocoding, mapping, and resource estimates, are given in the respective sections.

Data sources

Several different types of data relevant to nutrition were used, and the sources and development of these data are described below. These are:

1. Anthropometric and related data.
 - a. Household surveys: DHS: 2000 (referred to as survey 1); 2005 (survey 2); 2011 (survey 3); and 2014 (survey 4 – these data were obtained later in the analysis). Most of the analysis was done on surveys 1 through 3, with correlational analysis using survey 3 primarily.
 - b. Data from the National Nutrition Programme (NNP) weighing program: initially as analysed up to end-2012, then using the MS Access database in UNICEF-Addis.
 - c. Data from NNP evaluation surveys.
2. Resources:
 - a. DAC (Development Assistance Committee of OECD) database: 2012 was initially available, and 2013 become available later.
 - b. Program data assembled by FMOH (and REACH); also combined with DHS data.

DHS data

The Ethiopian Demographic and Health Survey (EDHS) 2011 children's recode dataset was used for preliminary assessment. Surveys from 2000, 2005, 2011, and 2014 were subsequently merged to give a single child-level dataset. Unique identifying variables were created within all datasets prior to the merge to allow for ease of matching variables later on. Identifiers were

created at the level of survey year, cluster, household, woman/mother, and child and are described further in table 2.1A. Details below (e.g. for outcome variables) are given primarily for survey 3, the one mainly used; procedures for the other three surveys were analogous. (Where variable names are used this is for ease of reference.) All data handling, merging, and analysis was done in SPSS version 22.

Data standardization and cleaning

Outcome variables

Child outcomes The data cleaning began by determining the number of cases with valid measurements for the indicators of child nutritional status: height-for-age z-score (HAZ), weight-for-height z-score (WHZ), and weight-for-age z-score (WAZ). Child's age, height, and weight are used to calculate the three indicators. There were 11654 total cases in the survey 3 dataset, but only 10480 with a value for child's age in months, which ranged from 0 to 59 months, or less than 5 years. The height and weight variables were then checked for missing values and some additional values were converted to missing such as those coded 999 or 9999 (called 99xx later), labeled "out of normal range". Once these were relabeled as missing, the total number of cases with valid height, weight, and age was 9892; this matched the number of cases with a non-missing HAZ, WHZ, and WAZ, which were already calculated in the DHS data (variables HW70, HW71, HW72). The initial and final sample sizes are shown in table 2.2A. Cases that were missing on HAZ, WHZ and WAZ had not been measured for height and weight (variable V113) due to the child being dead, not found, refusing measurement, or not present: numbers are in table 2.2B.

The primary outcome variable used for this analysis is the HAZ score. The next step was to check the range of the HAZ variable. The dataset already limited the range from extreme height measurements by coding cases with heights below 45 cm and above 120 cm as 9996 for HAZ, labeled "out of plausible height range." Similarly, the WAZ variable was coded 99xx for those cases with weights below 2.3 kg. Once the 99xx's of the HAZ, WAZ and WHZ variables were set to missing, 9611 cases remained. The range of HAZ scores was -6.00 to +5.95 with a standard deviation of 1.76. This range is considered too wide to be accurate, and taking account of the distribution, a smaller range was created. Considering the unlikeliness that a child's HAZ score is below -5, this was selected as the lower limit since many cases with scores less than this are probably erroneous. The upper limit was set to +4.5, so that extreme cases at the high end of the data would not drive the results, but avoided eliminating as many cases as possible. These decisions are somewhat arbitrary but necessary to accurately assess what is happening with the majority of the data. Descriptive statistics of the HAZ variable (HAZCI) are in table 2.3.

The merged dataset with surveys 1, 2 and 3 required the application of the WHO macro to create the HAZ, WAZ, and WHZ variables since surveys 1 and 2 had used the old reference standards.¹ The special SPSS version of the macro for DHS individual data was employed; the links to download the syntax can be found here: <http://www.who.int/childgrowth/software/en/>. This was done to the survey 3 data as well, even though the existing z-scores used the new WHO reference

population. The resulting z-score variables in survey 3 were slightly different from those in the original 2011 dataset (variable HW70 and HAZCL, described above), but very minimally so.⁶

Woman outcomes In addition to child HAZ, Women's BMI was assessed from the 2011 survey, as prevalences <18.5. Anemia was calculated from the same survey using the haemoglobin levels in the data, not adjusted for altitude (thus directly comparable across regions), with the main indicator being anemia in non-pregnant women (cut point 12.0 g/dl).

Lying/standing, length/height measurement errors

Many children were improperly measured for height or length for their reported age, based on the variable that indicates this measurement type, V115. This is important because adjustments are made to correct for incorrect measurement for age during the calculation of height dependent z-scores. The WHO standards for assessing anthropometry indicate that recumbent length should be used for the measurement of children less than 24 months and standing height should be used for children 24 months and older.² A crosstabulation of child's height with the variable indicating whether height was measured lying or standing clearly illustrates this problem, see table 2.4B. WHO also states that recumbent length is approximately 0.7 cm greater than standing height due to gravitational and compressive forces;² this is the adjustment made during z-score calculation, i.e. 0.7 cm is added to a child's height if measured standing when it should have been lying, and 0.7 cm is subtracted from a child's height which if it was measured lying when it should have been standing. However, applying such a correction in this dataset would not suffice to correct the problem since cases measured standing are, on average, 3 cm *taller* than those measured lying down at every age (in months) for children ages 21 to 27 months. The error was more extensive in the direction of incorrectly measured lying among the 24 months and older: overall 19.5% of measurements were lying when they should have been standing, according to reported age (see table 2.4), with 4.9% the other way. Probably these errors were in part because of miscommunication or misreporting of age. In any event, the differences are so large that they constitute a worrying source of possible errors in analysis, and in proper calculation of child's HAZ.

The numbers of children in survey 3 around 24 months measured lying or standing are illustrated in figure 2.1: this should have no children measured standing under 24 months, and none measured lying at 24 months and older. The error is greater in the 24 months and older group. As shown in figure 2.2, the differences are up to 5 cms or more, which makes a big difference to the HAZ calculation. Possibly the age (or DoB) from the questionnaire was recorded at a different time than the length/height measurement, so the age given when deciding whether the child should be lying or standing was different to that recorded; or the guidelines were not followed. Given the large differences in HAZ, it appears that the mismeasured children's ages were probably wrong, and the actual source of error. The difference in HAZ, for example, at 24 months is between -2.14 (n=106) measured lying (incorrectly) and -0.98 (n=57) measured standing. If wrong age is a significant source of this problem, then adding a correction in terms of cms would be incorrect anyway – it is not that a child's length is really differing by 5 cms between lying and standing, but that children are wrongly categorized by age. Moreover this error varies by survey (see table 2.5). In view of this we calculated both excluding and including

⁶ The difference is believed to be due to a difference in rounding.

those wrongly measured. A variable (Mgood) was created to = 1 when the child was correctly measured, and = 0 when not.

Further, as we progressed, the checks for comparability (see below) were applied to the Mgood = 0 or 1 groups as well, to check whether excluding Mgood = 0 biased the results.

Considering the severity of this measurement error, analysis was usually done on separate groups: those less than 24 months who were measured lying down, excluding 4.9% of this age group (2011 data), and those 24 months and older who were measured standing, excluding 19.5% of this age group (2011 data).

Age heaping

Preference for exact ages (12, 24, 36 ... months; also, but less so for 18, 30 ...) is common to all surveys where indices rely on age, as with HAZ. There is no good work-around for wrong ages, and the best solution is taking enough time during the survey with a local calendar to find out the birth date; even then some age heaping is found. Thus the usual approach is to hope that the age heaping does not change between surveys, and especially that the rounding down usually experienced stays the same (e.g. a child of 26 months will often be called a 2-year old). Both these features of age heaping can be checked.

In the Nepal report³ we introduced a metric of the extent of age heaping. Briefly, this fits a regression line to the age distribution (e.g. a nearly horizontal line through the vertical bars in figure 2.3, derives the residuals (how far each age frequency is from the mean), removes their signs, adds them together, and divides by the total N (i.e. mean absolute residual, MAR). This gives an arbitrary measure that is comparable across different sample sizes and surveys, for the same age range; the value is typically around 0.1, and the lower the better. The frequencies by age for the DHSs used here are shown in figure 2.3. The age heaping got slightly worse with time – the 2000 survey is the best – and the extent of age heaping is for example greater than in Nepal DHS surveys where the MAR was about 0.1.³

The errors detected by the length/height issue are considered to be a combination of age misreporting and failure to follow the length/height protocol, but these two cannot be distinguished from the present data.

Effects of removing mismeasured cases

Table 2.6 summarizes the measurement estimates at 18-30 months of age. As was seen in figure 2.2, standing measurement are always substantially higher than lying, at all ages. In the 18-23 month group, a minority of children were wrongly measured (96/791 = 12.1%), thus the effect of removing this group on the mean HAZ and prevalence is fairly small, reducing mean HAZ by 0.123 (difference between -2.024 and -1.901). However, in the 24-30 month range, half the length/height measurements are done wrong (608/1193 = 51.0%), so removing those incorrectly measured improves the HAZ much more (0.508, = difference between -1.938 and -1.430). Thus on balance removing the incorrectly measured children improves the HAZ (in 18-30 months children) from -1.923 to -1.752, equivalent to prevalences from 50.1% to 45.0% (these

differences are all $p < 0.001$). This is the main reason that cleaning the data by removing incorrectly measured children would give an estimate of better nutritional status as height-for-age in the 2011 survey than in the original data.

A different approach is to use weight-for-age, which is not subject to the mismeasurement problem (lying/standing), but is vulnerable to age misreporting. The results reported later show similar trends to HAZ, with a steady improvement of about -1.5 percentage points (ppts)/year, when we remove the mismeasured children, who are also suspected of having misreported ages.

Independent variables

All variables were checked for missing values and appropriate range. Table 2.1A gives details of all the variables created from existing variables for use in analyses. The table includes the original DHS variable name, new variable name, derivation or formula used to recode or calculate, and any notes on missing values, etc. The original DHS variables used differed, at times, across surveys by name and/or values and categorization. As a result, some variables are created for each survey independently, and then joined together. Merging the dataset prior to re-categorizing variables required careful consideration of what the values meant in the original datasets. The merged dataset took variable values and labels from the 2011 survey, which, at times have different meanings than the identical variables and values in the other survey years.

For infant and young child feeding (IYCF) practices, definitions provided by WHO were used, and variables recoded as needed to match these.⁴ These definitions are in table 2.1B.

Some general rules applied to recoding all of the categorized variables. All responses of “don’t know” or “not a de jure resident” were recoded to missing. Responses of “other” were usually recoded in multiple ways. First, “other” was kept as its own category during the first phase of consolidation to more than 2, but less than the initial number of categories. Second, during the dummy variable formation stage, two variables were created, the first treated “other” as missing, and the second treated “other” as part of the 0 category. For example, roof is the consolidated roofing variable which compressed the existing variable V129, initially 8 to 12 categories across surveys, down to 4 categories, one of which was “other.” Roof converted to missing responses of “don’t know” and “not a de jure resident.” The dummy variable(s) for poor roof take values of 1 for poor roof, and 0 for not poor roof. In the first iteration, D_PoorRoof, “other” is converted to missing resulting in the loss of some cases. In the second iteration, D_PoorRoof2, “other” is included in the 0 category of not a poor roof. Most analysis uses the version that retains the most cases, in this case, D_PoorRoof2.

Similarly, toilet facility type (variable V116) was used to assess sanitation facilities: this variable was recoded as a dummy variable where no toilet facility/ bush/ field was coded as 1 and all other toilet facility types were coded as 0, including the “other” category. Source of drinking water (variable V113) was used to assess water supply. This was recoded to a dummy variable that compared those who used surface water (including protected spring, unprotected spring, river, dam, lake, ponds, stream, canal, and irrigation channel) or rainwater as their drinking water source (coded as 1) versus all other sources (coded as 0). These recodes are given in table 2.1A.

As further examples, child's age and sex were included in all regression models to control for their known effects on height. These variables, HW1 and B4 from the DHS datasets, did not require additional recoding or cleaning; there were no missing cases and no out of range values – besides the theorized misreporting of age and age heaping described previously. In addition, mother's education was included in most models to control for this always-important determinant. The variable used was highest education level of respondent (variable V106), from which was derived a dummy variable for 'no education', the lowest group alone taking the value 1, versus all other groups taking the value 0. Two variables were used to control for wealth or socioeconomic status: a dummy variable for the poorest wealth quintile (taken from variable V190) and a dummy variable for unimproved roofing (no roof or roof made of thatch, leaf or mud; from variable V129), which is viewed as a proxy for low socioeconomic status. These two variables, poorest wealth quintile and poor roof were never included in the same model due to their high level of collinearity, but rather were used to confirm conclusions of other models. Generally, poor roof was used more often.

Analysis methods

Descriptive analysis

Analyses of variables possibly correlated with HAZ begin with assessment of descriptive statistics of the individual predictor variable; means or percentages are presented by groups, usually in national/total, regional, livelihood, and urban/rural categories. Some topics include these descriptors for all survey years, 2000, 2005, and 2011. Tables of bivariate associations with HAZ follow these single variable tables, within the same groups: national, regional, livelihood, and urban/rural. These are often included in the supplementary material in order to stream line the main text tables. Trends within individual predictor variables and the bivariate associations with HAZ across survey years can be gleaned from these tables but are often not discussed in text in order to remain on-point and minimize length.

Correlational analysis

Tables {SM WASH 27} and {SM WASH 28} from the WASH chapter display bivariate correlations between most independent/ predictor variables used within the two age groups: cases less than 24 months measured lying down, and cases 24 months and older measured standing. These show the substantial extent of collinearity between important variables, which was useful to guide model specification.

Linear regression using the ordinary least squares technique was employed to assess the relationships between several possible predictive variables and the outcome of child growth, primarily HAZ. The models were built sequentially, not in a stepwise manner. The first model included only the independent, possibly predictive, variable of interest to clearly determine the *un-weighted* bivariate association (this differed from the bivariate associations given in descriptive section via tabulation since those were usually *weighted*). The second model added child's age and gender, to determine any confounding by these variables; for example, age was a strong confounder of the relationship of several IYCF practices, due to varying feeding practices within age groups. The next model usually included education of the mother/ respondent, using

variable D_NoEd (no education). The following model included poor roofing to proxy for socioeconomic status, and the final model added mother's height. At times, poor water source and/or no toilet facility were also included, usually after poor roofing and before mother's height.

The interactions between the primary independent variable of interest and other variables in the model were always checked as each variable was included, and were kept in the subsequent models if the interaction variable had a $p < 0.1$. If in subsequent models the interaction p-value rose above 0.1, it was then removed for the following model. All interaction variables were calculated by multiplying the two variables together; these are not included in the table 2.1A but all begin with "I_" in the dataset (e.g. I_HomeEd is the interaction term of home delivery and education, which is from D_HomeDel2 * D_NoEd). If an interaction term remained significant at $p < 0.1$ throughout all of the models, it was further assessed through tabulation which calculated adjusted means within category of the interaction, calculating cross cell p-values. For example, an interaction between poor water source and education that remained significant in regression analysis would be further explored by calculating the two-by-two table of mean HAZ by water source and education, along with the corresponding 4 p-values. This allowed the direction of the interaction to be understood so conclusions could be drawn. Figures accompany the two-by-two tables for ease of understanding. These two-by-two interaction tables were usually adjusted for all of the other independent variables included in the regression analysis, though some may be un-adjusted (this is indicated in table titles).

Weighting

The data was weighted according to DHS guidelines using the variable V005 divided by 1,000,000, calculating the variable named Weight. As recommended by DHS and is common in statistical analysis, the data was weighted for descriptive statistics calculations, but remained un-weighted for all regression analyses for investigation of correlations. Interactions were usually tested both un-weighted and weighted through un-adjusted and/or adjusted two-by-two tables, then also graphed as figures (described above). Often, the weighted interaction table(s) is left out of the main text and put into the supplementary material. Weighting usually resulted in a diminished, but still present, effect in the interaction tables.

A further affect of weighting, and thereby the likely cause of diminished correlational effects, was the reduction of sample size. As a result, anytime weighting was used, the un-weighted sample size is also given so the observer can be assured of the true sample from which the statistic was derived. For un-weighted analysis, only the un-weighted sample size is given.

Factors affecting validity and interpretation

Sample comparability by long-term stable factors

Although the samples were drawn to be representative of the regions, and nationally, we can check if this succeeded in producing valid through-time comparisons by checking factors that are associated with child anthropometry, but should change little over the time period studied. Variables such as height and age of respondent are clear candidates for this.

The mean respondent's height was almost identical between surveys: 2000, 156.6 cms; 2005, 156.9 cms; 2011, 156.6 cms. Age of respondents was similarly unchanged, with a mean of 29.5 years. Examining these results by region, again the results were nearly identical, with less than a cm difference across surveys (except Tigray, which had 155.4, 157.0, and 156.0 cms). This was taken as reasonable evidence that the surveys were comparable in terms of likely SES.

Effects of seasonality and drought

A crop calendar is shown in figure 2.4, with tentative assignments of regions to the different cropping systems. This is needed mainly to understand how the surveys are comparable taking account of the lean season (shown in red); the survey timings are included. A map of administrative regions is included, as figure 2.6. The 2000 and 2011 surveys should be comparable, taking place during the lean season in the pastoral areas (lower two calendars), before and into the start of the lean season in the 'belg-receiving areas', and before the lean season in the western agricultural areas. The 2005 survey was after the lean season in the first two, in the lean season in belg areas, and going into the lean season in the west.

There is not much information on the expected effects of seasonality on anthropometric indices. A study we did a few years ago⁵ (estimated that up to 5 ppts change could occur in wasting (low wt-ht) prevalence between lean and post-harvest seasons. Presumably this would be reflected in weight-age, but probably less, and later, in height-for-age.

We also need to know the context of food security, in Ethiopia related particularly to drought. National data are easier to get for this than regional. Information on drought and food crop production can be used to assess the extent to which these may affect the survey results. Production estimates were evaluated in ⁵, for the period 1989-2005, and similar procedures were used here for data retrieved through 2013, from the FAO Foodcrops and Shortages series ⁶. The plot of these estimates is shown in figure 2.5, and the deviations from the averages (residuals, figure 2.5 B) help to define drought years at national level. In addition, FAO reports from around the survey time were looked up for information on areas specifically affected.

The national level results (figure 2.5) indicate that in the period 2000-2004 production was far below the trend, with the peak deficit in 2002, and only beginning to recover in 2005. After 2010 production increased rapidly, and was above average in the period around 2011 and even more in 2014.

Drought and production factors affecting 2000 survey results

Attempts were made to find more regional details around the times of the surveys, to facilitate interpretation of the nutritional data, drawing mainly on FAO 'Crop Prospects and Food Situation' reports. Harvests from 1995-9 were reported as above the average trend, but dropped below this in 2000. Since most surveys were in Jan-May, the effects of falling production may not have been felt by then in the highland agricultural areas. However, from the FAO report in April 2000: "In the pastoral areas of the east and south, particularly the Somali Region, which have had three consecutive years of little or no rainfall, (are) cause for serious concern. The

current drought has killed large numbers of livestock and people are migrating in search of water and food.”

Further: “The secondary “Belg” season crop, which accounts for up to 10 percent of annual grain production, has failed. With this failure, the number of people in need of assistance has increased to more than 10 million people, including 400 000 displaced by the border war with Eritrea.” (FAO, Aug 2000).

Drought and production factors affecting 2005 survey results

Harvests improved in 2004, but FAO reported in Feb 2005 that over 2 million people would need food assistance. In Sept 2005, good prospects were reported for W and Central Ethiopia, less good for E and S crop producing areas. Rainfall had been below average in the SE (FAO, Apr 2006), and food problems were ‘particularly serious’ there. FAO estimated (Apr 2006) that 10 million people were vulnerable, of which an acute drought emergency affected 2.6 million, 1.7 million in the SE pastoral areas.

Thus in mid-2005 the population in W and C Ethiopia cropping areas was recovering from a severe drought which had started in 2000. The SE pastoral areas were still badly affected.

Drought and production factors affecting 2011 survey results

The year 2011 was generally good overall for harvests, but in the southern pastoral area rains failed and these areas did badly. Belg rains were also poor, but this should have been during the survey, thus not affecting its results much. The rest of the country contributed to production at better than trend levels (2010 and 2011). (From FAO reports March and June 2011.)

Wasting prevalences and increased mortality risk

In analysis of anthropometric and mortality data from the Horn of Africa, published in 2010,⁷ we found that the relation between wasting prevalences (WHZ < -2SDs) and child mortality was (a) non-linear, mortality only rising after a certain prevalence was reached; and (b) the wasting level at which this increased mortality started was very different between agricultural and pastoral livelihoods. This meant that the guidelines from WHO⁸ that gave single cut-offs (e.g. 15% wasting as an emergency) irrespective of livelihood are inappropriate. This is in line with the different growth patterns between these groups⁹. We estimated approximately that for agriculturalists, the cut-point should be 10% wasting as the level at which child mortality may increase above normal; and for pastoralists, at 20% wasting child mortality may increase above normal. These cut-points are used in interpreting the data here.

Resources

DAC database

Information from the 2012 and 2013 DAC (Development Assistance Committee of OECD) databases was analyzed to gain information on spending in Ethiopia for nutrition-specific and nutrition-sensitive programs. Initially only the 2012 database was available and slightly different methodologies were used to analyze the two due to time restrictions and lessons learned from the first round of analysis. For the 2012 database, all projects under the DAC sector name 'Basic Health' and purpose name 'Basic Nutrition' (purpose code 12240) were analyzed for relevance to the current project. A sample of projects from relevant DAC purpose codes based on the recommendations in the SUN Donor Network 'Draft Methodology and Guidance Note to Track Global Investments in Nutrition' was analyzed to determine relevance (purpose codes included: 12110, 12220, 12250, 12261, 12262, 12281, 12240, 13020, 13010, 14030, 14031, 14032, 14010, 14015, 14020, 14021, 14040, 14050, 14081, 15170, 31120, 31181, 31166, 31193, 31150, 31182, 31191, 31161, 31163, 31140, 31110, 31130, 31191, 31210, 43040, 16010, 52010, 72010, 72040, 74050, 73010). For the 2013 database, only projects with over 1 million USD committed were analyzed as they contributed 89.8% of the total project funds committed in Ethiopia for that year. The same purpose codes and inclusion criteria were used for each year.

Projects were categorized as nutrition-specific, nutrition-sensitive (full), or nutrition-sensitive (partial) based on the title and long description provided by DAC in accordance with relevance to the current project. Criteria for nutrition-specific projects included outcomes that were directly related to nutrition (decreased prevalence of stunting, wasting, and/or underweight). Nutrition-sensitive (full) projects would likely have an indirect effect on nutritional outcomes through improvement in agricultural development/productivity, improved market connections, reduced risk and vulnerability, and/or income generation. Nutrition-sensitive (partial) project commitments were used to strengthen policy/knowledge development and institution building, monitoring and evaluation, water, and or climate change. The project commitments for projects deemed to be nutrition-specific or nutrition-sensitive (full) were summed up and used for further analysis. Nutrition-sensitive (partial) projects were not included.

Program data assembled by FMOH

The analysis used a database assembled through a stakeholder mapping conducted in 2013 by FMOH with support from FAO, UNICEF, WFP, WHO through the Renewed Efforts Against Child Hunger and undernutrition (REACH) initiative.¹⁰ An MS Access database was developed to document the multilateral and bilateral agencies and NGOs working in nutrition in Ethiopia; the woredas and zones where they actively supported nutrition programs over the period 2013-2015; and to classify existing nutrition programs into 54 types nutrition interventions identified from the 2013-2015 National Nutrition Program (NNP) Guidelines.

The database was constructed from questionnaires and interviews with 49 organizations working in health and nutrition in Ethiopia, of which 40 organizations reported working in nutrition and 32 reported active nutrition programs implemented at sub-national level over the period 2013-2015. Data were reported for all 802 woredas in the country. The 54 types of nutrition

interventions in the database fell under the following categories: infant and young child feeding (IYCF); micronutrients; management of malnutrition; women and adolescent nutrition; water, sanitation, and hygiene (WASH); nutrition and infectious diseases; nutrition and non-communicable disease; nutrition, agriculture and food security; school health and nutrition; multisectoral approaches; capacity building, research, and monitoring/evaluation; and nutrition communications. The database also included information on the livelihood zone of each woreda; its ‘hotspot’ classification⁷; the implementation of large-scale programs (CBN, ENGINE, and PSNP); and the duration of each program. Data were not available on sub-woreda implementation (i.e. the coverage within the woreda). Financial resources associated with each program were also collected in the stakeholder mapping exercise, but were not available for this analysis.

Mapping

Data sources

Using the EDHS 2011 child level data, maps of anthropometry and determinant/situation variables were developed at the zone level. The FMOH Nutrition Stakeholder mapping database, developed by REACH,¹⁰ was used to identify program presence, and is further described above. Using this database, maps of programs by type or component were created at the zone level. Overlaying these maps identified zones deemed to be in highest need of certain programs as well as those currently receiving the programs they need.

The data used for the mapping section includes (further explanations are provided in the relevant sections):

- EDHS 2011 children’s recode dataset
 - Selecting only those children with the correct height measurement for their age, lying or standing (mgood=1).
 - Cases were weighted for all maps.
- EDHS 2011 geographical data
 - Identifies the latitude and longitude coordinates of the approximate center of each cluster.
 - Identifies lower levels of administrative areas, including zone and woreda, not available in primary DHS datasets.
- FMOH/REACH program database
 - Identifies program presence at the woreda level. Includes both general-category of programs and more specific components. For example, the WASH category includes both water and hygiene components.
- GADM map shape files of Ethiopia (www.gadm.org)

⁷ Using a locally adapted Integrated Phase Classification (IPC) approach, woredas are ranked by level of food security, disease outbreak, flooding, CMAM admissions, nutrition survey results and other related indicators. Woredas are then classified as Priority One, Priority Two, or Priority Three (One being the most severe), depending on the severity of the emergency situation. Non-emergency woredas are classified as Priority Four.

- The shape files were used to develop the maps in open source QGIS software. This is the source of the administrative boundaries depicted in all maps, which are not meant to be authoritative or exact.

Cluster-level geographical data

Cluster level geographical data is available in the form of latitude and longitude coordinates for the DHS clusters through the DHS website. The geographical data includes information on livelihood groups, along with the zone and woreda in which the cluster falls. To protect the confidentiality of individuals, DHS states that the clusters have been randomly displaced by 0 to 10 kilometers in any direction, depending on the urban or rural location.¹¹ The random displacement is corrected to fall within the administrative 2 boundaries in which the cluster truly lies; the zone identified by the geographical coordinates should be the clusters true zone.

Some clusters are missing geographical data due to the difficulty of accurately determining latitude and longitude coordinates in the some field conditions. For EDHS 2011 there are 25 clusters that are missing geographical data out of 596 total clusters. Therefore, these clusters are also missing livelihood, zone and woreda information. Within these clusters were 270 un-weighted cases, among cases whose height was correctly measured for their age (lying or standing, with anthropometry data. As a result, all information on these cases has not been included in the mapping exercise. The 270 lost cases are out of a total un-weighted sample of 8381 cases with the correct height measurement from EDHS 2011, resulting in a loss of only 3.2%. Since DHS includes the region regardless of geographical data, it is possible to assess the regional location of the lost clusters. Table 2.7 illustrates the regional distribution of the lost clusters. The region of Somali experienced by far the most lost cases of 146 due to a lack of geographical data. As a result, conclusions from the mapping analysis regarding Somali should be accepted with caution.

Woreda-level program data

A separate dataset provided by REACH (2014) was used to estimate program presence. This dataset was at the woreda level. Using the woreda information gained from the geographical DHS data, the woreda-level program data was matched to woreda's in the DHS data. Merging the REACH data into DHS resulted in 100% of DHS woredas matched. After the merge, each child within a woreda received the same REACH data. The program data included summary and sub-category variables. For example, if there were any programs regarding IYCF in the woreda, the woreda, and all children residing in the woreda, received a score of 1 for the summary IYCF program presence variable. This was derived from the several IYCF program sub-categories. So, for more specificity, information was also available on the presence of breastfeeding promotion programs and/or complimentary feeding promotion programs, among many other IYCF component programs. The scoring for these was done in the same way as the summary variable. If any organization was operating a program with a breastfeeding promotion component, the woreda, and all children within the woreda, received a score of 1 (program present) for the breastfeeding promotion program variable. More information on the REACH database can be found in the Nutrition Stakeholder Mapping 2013-15 Final Report.¹⁰ The program data also included what organizations were operating the programs, but this information

was not merged into the DHS child-level data in order to simplify it as much as possible, and retain only relevant and necessary variables for the mapping exercise.

Note that program data was collected after the EDHS 2011 child-level data was collected. The program data is used for assessment of future program need only, and should not be considered evidence of program effect in any way.

Map Source: GADM

The maps used for this analysis are taken from the Global Administrative Database¹² and are constructed in open source QGIS mapping software. The GADM map boundaries do not exactly match the official administrative areas. For instance, the GADM map includes 72 zones, whereas the most recent official list of zones in Ethiopia includes 100, including 4 special zones. The reason for so many fewer zones is often that a special woreda, an officially listed zone, has been incorporated into its surrounding zone in the GADM map. For instance, in Benishangul-Gumuz, the Maokomo Special zone is absorbed by the surrounding and nearby Asosa zone. Additionally, some zones have been combined. For example, Gambela's 4 official zones have been combined into 2 in the GADM map. Although this loss of zonal specificity is not ideal, this was the best map available in the necessary shape file format for this project.

Zone-level mapping

Merging data and aggregating to zone level

The geographical DHS data provides the latitude and longitude locations of the approximate center of each cluster. This location is then displaced randomly by less than 10 kilometers, as described previously, but is supposedly corrected to remain in the zone that the cluster was originally in prior to displacement. This was checked using the QGIS software. First the locations of the DHS clusters were imported into QGIS, at the individual case level. Then, the cases/clusters were captured by whatever zone they fell into on the GADM map. The cases were then exported from QGIS with their newly captured zone from the GADM map. It was then possible to aggregate useful DHS variables at the zonal level using the zones from the GADM map. However, prior to doing this, the spatially captured GADM zones were cross-checked with the zone names that were given in the DHS geographical data. Possible deviations due to misspellings and name variations (or duplicate zone name across regions) were overcome by comparing the region and woreda names associated with each zone. If the zone name captured by the GADM map matched the name given by DHS, there was no concern for possible misplacement of data. However, where they differed, a decision was made as to whether the DHS given zone, or the spatially captured GADM zone. Although there should have been no mismatched zones, based on the DHS correction to zone level, the mismatches could have been due to inaccurate boundary placements within the GADM shapefile and/or the consolidation of zones in GADM map as mentioned previously. Generally, the spatially captured zone was used if the zone name did not match due to its inexistence in the GADM database.

Once the process of assigning the best fitting zone to all cases concluded, it was possible to import the necessary child and program data into the mapping software. First, the relevant child

level variables, including the newly merged in program data, were aggregated at the zone level. This aggregation process took the mean value across the zone of variables from the child data. This resulted in each zone receiving a continuous score between 0 and 1 for all variables that were dichotomous (0 or 1 for yes or no) in the child-level dataset. For example, the variable of “no toilet” from the child-level DHS data was in the form of 0=no, 1=yes (yes means child’s household has no toilet access). In the aggregated zone-level file the no toilet variable may have a score of 0.46 meaning that 46% of children in the zone are in households with no toilet access (this is only among the children used for mapping). Most of the DHS variables and all of the REACH program variables were in this format – originally dichotomous. A few DHS variables used were originally continuous, such as the continuous z-scores for anthropometry: HAZ, WAZ, and WHZ. So the zone aggregation simply resulted in the average z-score among all of the children in the zone, and are easily interpreted as such. The zone aggregation resulted in a dataset with 72 zone cases, based on the number of zones in the GADM map. However 6 of the zones did not have any DHS cases in them; these have been greyed out in all of the maps. In addition, several zones had fewer than 30 un-weighted DHS cases. The complete list of zones with 0 to 29 un-weighted DHS cases can be found in table 2.8. The zones with DHS cases less than 30 were still mapped (not greyed out); therefore it is important to view conclusions on these zones with caution.

Decisions in mapping and combining groups

Once the DHS and REACH program data were aggregated at the zone-level, this data was imported back into QGIS to create the maps. Several decisions were made in regards to displaying information. It was decided to use three categories of each variable used so as to not oversimplify it into two, but also not create too many possible combinations in the overlay maps. The three categories were created in the form of tertiles, meaning the zones were ranked in order and split into three even groups. However, with some variables, more than one third of the zones fell into either 0% or 100%. In these cases the tertiles are not evenly enumerated. Instead, all zones with 0% are assigned tertile 1, zones greater than 0% but less than the top third of the zones are assigned tertile 2, and the top third of the zones are assigned tertile 3. With this method, the middle tertile is sometimes much smaller in number of zones than the other tertiles. This often occurred with the program data from REACH as many programs have a minimal presence, 0% across much of the country, or are very large presence, with 100% coverage in many zones. This method of ranking zones into tertiles is meant to compare that variable across the country, not to predefined cutoff points. The cutoffs for each tertile are indicated in the legend of each map. It is important to absorb where the cutoffs are before reading the map and making conclusions, as they vary greatly across programs and situation variables. The tertile format is used for all of the single variable maps including: anthropometry (prevalence’s), program presence, and situation (independent DHS variables).

The process of overlaying the maps required further decisions of how to group various categories into something meaningful. Combining three, tertiled variables, results in 27 distinct categories, which is far too many to be useful. Therefore, a grouping method was designed to indicate various levels of need. The grouping model consisted of two pieces: need and program presence. Need was defined by combining the anthropometry and the situational variables. It was decided at this stage to use underweight prevalence for all of the overlay maps since it captures need

based on stunting and wasting. So, if a zone was in the lowest tertile (best off compared to other zones) of underweight, or the lowest tertile of the situational variable (ex. no toilet) they were deemed to be a low need zone. Zones that fell in the highest tertile (worst off) of both underweight and situation are considered highest need. So, the zones that fell in the top two tertiles of both underweight and situation, excluding the highest need combination, are deemed to be medium need. When program presence is added to these need combinations, 6 groups resulted: Priority A are highest need zones in the lowest (fewest) tertile of programs; Priority B are medium need zones in the lowest tertile of programs; Priority C are medium to highest need zones in the middle (some) tertile of programs; Good Targeting are zones in medium need that are in the highest (most) tertile of programs; and Best Targeting are zones in highest need with the highest tertile of programs. Any zones not falling within one of these groups are in the lower need group. Looking at the tables presented at the end of each section will further clarify these groups.

Presentation of maps

Sections of maps are based on need for certain programs. Sections included in mapping are: WASH, PSNP, IYCF/CBN, and access to health services. Within the WASH section are several groups of maps since WASH programs are comprised of both safe water and hygiene programs, providing three different program maps to use. In addition, the situation variables to use with WASH include both poor water source and no toilet. This resulted in 4 groups of maps within the WASH section: (1) WASH programs with poor water source; (2) WASH programs with no toilet; (3) water programs with poor water source; and (4) hygiene programs with no toilet. The IYCF/CBN section similarly included two groups of maps, this time using the two different programs.

Within each primary section, anthropometry results are presented first, including stunting, underweight, and wasting prevalence in zonal tertiles. These are repeated at the beginning of each main section. Within the sub-sections, the single variable maps of program presence and situation (i.e. no toilet, poor water source, etc) are presented in zonal tertiles. Then, the two overlay maps are presented, starting with the map illustrating priorities A and B only to highlight the highest need zones, followed by the full overlay map with all priority groups presented. Lastly, the tables are given with the numbers of zones that fall into each priority group, along with the original 27 categories from the 3 by 3 by 3 cross tabulation. The specific zones that fall into priority A and B are given in the footnotes of the first table. To aid in interpretation, colors have been added to the 27-cell cross tabulation table to match the colors of the priority areas depicted in the full overlay map.

Supplementary Materials

“Supplementary materials” will be put on our website, <http://tulane.edu/publichealth/internut/>. This contains detailed results that are not essential for the main text, but are important to keep associated with this report. Putting this on the web has the advantage that length is not a problem. It is suggested that ‘Supplementary Materials’ would normally be accessed when referred to in the different sections, rather than being of interest as self-standing material.

Supplementary Materials Outline

2c. Risk factors

Supplementary material includes additional statistics results in tables and figures that are less essential than the primary tables and figures, but do hold some importance to interpretation and conclusions.

- WASH
- IYCF
- Access to health services

3.c. Case studies

Supplementary material includes selected project summaries, woreda case study reports, and National Nutrition Project strategic objectives tables.

- Ethiopia Nutrition Project Summaries – Case Studies
 - The Agricultural Growth Program
 - Alive & Thrive
 - Empowering New Generations to Improve Nutrition and Economic Opportunities
 - UNICEF WASH programs
 - Productive Safety Net Program
 - Community Based Nutrition Program
- Woreda Case Studies
 1. Halaba
 2. Kindo Koyisha
 3. Ofla
 4. Sekota
 5. Bure
 6. Limu bilbilo
 7. & 8. Asayita and Kori

National Nutrition Program (NNP) Strategic Objective Tables

- NNP Strategic Objective 1: Improve the nutritional status of women (15-49 years) and adolescents (10-19 years)
- NNP Strategic Objective 2: Improve the nutritional status of infants, young children and children under-5
- NNP Strategic Objective 4: Strengthen implementation of nutrition sensitive interventions across sectors
 - NNP Strategic Objective 4:1 Agriculture sector
 - NNP Strategic Objective 4:2 Education sector
- NNP Strategic Objective 5: Improve multisectoral coordination and capacity to ensure NNP implementation

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2. Nutrition Analysis for Guiding Decisions on Interventions

2.B Trends and Differentials in Nutritional Status

Summary

The national rate of improvement in stunting was estimated as 1.5 ppts/year, 2000-2011, likely continuing to 2014. This is presently the fastest in Africa, and may be the fastest national African level estimated at any recent time. The improvement was consistent across the country, except for the lowland pastoral areas (Affar and Somali) recently affected by drought. Actual prevalences were not much different between livelihood groups (pastoralist, agricultural, agro-pastoralist).

Distinguishing groups by important determinants of child malnutrition (e.g. maternal education, absolute (no-assets) poverty), almost all the population improved at about the same rate – e.g. the poorest groups in 2000 and 2011 improved by the same difference in prevalence. Income, consumption and expenditure grew rapidly – income by 10% or more per year – and this accounted for much of the change. However, additional change due to, for instance, moving out of absolute poverty or increased proportions educated, can be seen. Child nutritional status is the same across all but the richest income quintile at any one time; the stunting – wealth lines shift down with time but remain largely flat. There is evidence that the CBN contributed to this improvement for the 30-50% participant children – indeed the 2008-15 weighing data appear to show that malnutrition is almost eliminated for these children.

Anemia in women is much different by region – more than double the national average for example in Tigray and Affar. Anemia is like child malnutrition in relation to wealth, only improving in the richest quintile. Moreover it appears to have improved substantially for those areas with already relatively low levels, but hardly at all in those regions most affected in the north. On the other hand, women's low body weight (for height, i.e thinness, measured by BMI) – again relatively unaffected by wealth – has changed hardly at all in the last 15 years, and is at almost double the prevalence in Tigray and Affar. The reason for this lack of change, strikingly different to that in children, is not estimable from the data.

The picture viewed in the longer term fits very well into expectations from the demographic transition now well under way in Ethiopia (IMR has plunged, and TFR is now nearly 4). Child malnutrition prevalences were probably stable until around 20 years ago, then started an accelerating fall, of which Ethiopia is now in the middle. If policies such as those for economic growth, education, and nutrition interventions continue, an end to stunting can be foreseen within the next 20 years.

National trends in child malnutrition

The estimated levels of child stunting at national level (weighted) for 2011 are shown in figure 2.7. Divergence from DHS estimates is mainly in the 2011 data, probably due primarily to length/height mismeasurement. These estimates indicate that steady and substantial

improvement in stunting occurred over the last 15 years. A number of checks were made to investigate whether these estimated changes were likely to be spurious, due to differences in sampling, age heaping, lying/standing mismeasurement, and drought and seasonality, as described in 'Methods'. The samples were considered comparable through time as assessed by long term stable factors, such as respondents' mean height, which was identical between surveys. Seasonality was probably similar as the surveys, except perhaps the 2005 survey, were at much the same seasons (see Methods, figure 2.4). Effects of drought are more difficult to assess, and need to be seen regionally, as discussed later.

The most serious problem was the variation in the large extent of mismeasurement of length/height, such that for instance up to 15% of children (in 2011) were measured lying when, since their recorded age was ≥ 24 months, they should have been measured standing; a similar problem is with children < 24 months measured standing when they should have been measured lying. This is gone into in some detail in the Methods section. Children measured wrongly standing were up to 4 cms taller for age: this is a very large amount and makes a substantial difference if not addressed. The fix we chose was to exclude children from the stunting estimates that were wrongly measured, and (for this and other reasons) make estimates separately for age groups 0-23 months and 24-59 months. The other approach used was to check results using weight-for-age; however the lying/standing error also appears due to age misreporting (see Methods), so this is only a partial fix. Excluding children (from all surveys) with the lying/standing error gives the 'corrected' line in figure 2.7, which we consider likely to be the most accurate estimate. It is however probably somewhat biased as there are fewer mismeasured children around 24 months in the earlier surveys (see table 2.5 in Methods), thus more children around 24 months in the earlier survey estimates.

Regional differences in child malnutrition

Estimates from DHS data

Prevalences of stunting (< -2 SDs of WHO standards) for 2011 by region are compared in figure 2.8. Stunting prevalences are 35-45% in most regions, except Somali and Gambela; Harari, Addis Ababa, and Dire Dawa are more urbanized, indicating an extensive problem of child malnutrition.

Rates of improvement by administrative region, shown in figure 2.9, are generally rapid compared to trends either historically – Ethiopia, before the 1990's,¹ fig 3 page 5^{2,3} or with other Sub-Saharan African countries^{4,5}, where the rates are generally below -0.5 ppts/year. Our estimates are compared with those calculated from DHS reports in table 2.9, and are slightly higher (in line with the data shown in figure 2.7), but do not alter conclusions. Improvements were excellent in the highest population regions, like Amhara, Oromiya, and SNNP. Only B-G, Affar, and Dire Dawa were a long way behind the trend. Tigray, having one of the highest prevalences, improved more slowly.

The effects of drought (see Methods section) need to be assessed here as changing either the starting prevalence (2000), or the ending one (2011). From FAO reports⁶ at the time, the Somali

region was badly hit by drought in 2000; and the belg rains (February – June) failed. These would have pushed the malnutrition rates up, and (certainly in Somali) increased stunting specifically. In 2011, harvests were generally better according to FAO, except for southern pastoral areas; belg rains were not good, but again it is not clear whether the timing is such that stunting would be affected. This all means that for Somali, both years were poor, but 2000 probably the worse, so that the rate of improvement of -1.6 ppts/yr in Somali likely included some recovery from drought in 1999-2000. The high stunting prevalence and slower improvement rate in Tigray (-1.2 ppts/yr) may also be related to a number of drought episodes reported by FAO; this may well apply to B-G (-0.5 ppts/yr). Otherwise, the 2000 and 2011 estimates by region may be comparable with respect to drought effects – but further information is needed and this is not a confident statement.

Before looking further at trends by area, we need to consider how far different livelihoods are affecting the estimates, in particular the difference between growth patterns of pastoralist and agriculturalist children. This growth pattern is known to vary from other data, for example as we showed in Chotard et al.,³ copied here as figure 2.10. However, estimates by livelihood (as coded in the DHS survey) in Ethiopia showed surprisingly little difference by livelihood, see Table 2.10. Therefore livelihood itself does not explain differences between regions; livelihood differences within regions will be investigated later as specific issues of Affar, Somali, and pastoralists.

Trend assessment by administrative region is hampered by low sample sizes, and some aggregation by agricultural area makes sense. The pattern suggested by the cropping pattern shown in the crop calendar from FEWSNET (see figure 2.5 in Methods) is used here. This gives four areas⁸:

- Western agricultural: W Tigray, W Amhara and B-G: here aggregated as Tigray and B-G
- Belg areas: Oromiya, Amhara, SNNP, Gambella
- Pastoral areas: Affar, Somali.
- Other: Addis Ababa, Dire Dawa, Harari

Data from the 2005 survey is also inserted here.

Western agricultural areas: Tigray and B-G. Over 2000-11, the prevalence of stunting fell at a rate of 1.2 ppts/year in Tigray, and 0.5 ppts/yr in B-G (the lowest rate seen). All this improvement was in 2000-5. Drought affected national production over this period (as far as we know including the western agricultural areas), so the robust improvement 2000-5 is somewhat surprising, particularly as the 2005-11 period had less drought, although FAO/GIEWS reported food insecurity in 2009-11. Thus the relative rates of change of stunting over the two periods – improvement 2000-5, none 2005-11 – is not readily explicable with the data we have, and needs further research to understand.

Throughout this period, child malnutrition as assessed by wasting prevalence was in the 10-20% range. As noted in Methods, we estimate that for those with agricultural livelihood, a prevalence of 10% indicates unusual risk; for pastoralists this level is estimated as 20%. This differs from the usual WHO cut-point of 15%, which not take account of different livelihoods and growth

⁸ We could re-analyse as we now have the codes, by crop area.

patterns. Thus this data shows that B-G, and Tigray to a lesser extent, had wasting prevalences well above emergency levels for agriculturalists, and nearing emergency levels for pastoralists.

This *western agricultural area* should be high priority for nutrition and food security interventions: it has the highest prevalence of stunting, a below-average rate of improvement (for B-G the lowest rate in the country), and unusually high wasting rates.

Belg-receiving areas: Oromiya, Amhara, SNNP, Gambela. In all regions except Oromiya, the improvement was faster in 2005-11 than earlier, and this corresponds to the improved national agricultural production estimates, related to drought, over this period (see figure 2.5 in Methods, from FAO data). SNNP had the fastest improvement rate in the country 2000-11 – and Gambela, it is estimated, halved the stunting prevalence. This however coincided with an apparent increase in wasting – this needs checking as it could be spurious, due to height mismeasurement (also look at wt/age by region) – but if real indicates wasting reaching levels where child mortality risk increases.

The stunting improvement rates in the 2005-11 period were particularly high (e.g. SNNP was at 2.6 ppts/yr). Probably some of this was making up for improvement held back previously by drought and related poverty and food insecurity. Nonetheless the overall rates for the decade, of 1.2—1.8 ppts/yr is remarkable. As an illustration, a sustained rate of 1.5 ppts/yr would reduce stunting to 10% or less within around 20 years.

Pastoral areas: Affar, Somali. These areas have been affected by drought, and displaced populations, intermittently throughout the 2000's. We expected less stunting in these populations and more wasting, related to livelihood, but this needs further investigation. Stunting in Somali appears to have been more affected in the earlier period, Affar later.

Wasting prevalences are high in both regions, and rose further (from the 2014 DHS published data) in 2014. The populations in both Affar and Somali have average wasting prevalences now above the emergency cut-point of 20% (as estimated by us), and well above the WHO value of 15%. The trend in wasting is cause for concern.

Other areas: Addis Ababa, Harari, Dire Dawa. Stunting prevalences are reaching relatively low levels in these more urbanized places, of around 20%; and the rates of improvement (except Dire Dawa), were above 1 ppt/yr. Wasting prevalences are also relatively low, around 5% in Addis and Harari, but just above 10% in Dire Dawa. These areas seem to be doing better than most, and are probably of lower priority in terms of the need to improve child nutrition.

Estimates from program data

The Community-based Nutrition (CBN) component of the National Nutrition Programme has included regular weighing of participating children since the launch in 2008. The CBN programme expanded by including new groups ('tranches') of woredas starting mid-year each year. The weighing results, summarized by woreda and month, were aggregated by tranche – by the 3-month period in which reports started coming in – and the trends by tranche, and then by region, provide independent estimates of trends in child malnutrition prevalences, estimated now

as underweight among programme participants. Note that this is not the population estimate, but taking account of participation rate, can give new insights. The data analysis was done by Tulane for the data through February 2012, with methods established and written up from the outset (see Methods). The data recently have been compiled and analysed as part of UNICEF's nutrition database.

The trends estimated by the four most populous regions from the CBN weighing program data by month, for the first programmes started in 2008 (tranche 1), are shown in figure 2.11. The consistent pattern is striking – and seen also in later tranches, and in sub-tranches, not shown – whereby the prevalence of underweight among child participants appears to fall from around 30-35% (consistent with DHS estimates of underweight), more rapidly at first, reaching about 10% after about 3 years. The credibility of the data is enhanced by small peaks appearing in the hungry seasons, followed by falls in the harvest periods. The participation rate for these data was estimated at about 30%.

The national level estimates up to 2015 from these data are shown in figure 2.12. During 2011-2 the system changed, and the weighing became the responsibility of the HEW rather than the community health/nutrition volunteer. We do not know whether this made a difference to the results, although at this level of aggregation it does not seem to have. The participation rates are similar. But the striking result is that the underweight prevalence has now reached well below 10%. If this is true, it represents an unparalleled impact on nutrition.

Estimates can be approximated to the implied national (or regional from figure 2.11) prevalences. Knowing that national underweight prevalence in 2005-11 was around 25-35% and up to 50% participation in woredas covered by CBN, the population prevalence in these must be around 15% underweight⁹. However viewed, this would be a massive reduction from the 42% prevalence estimated in 2000 – a rate of about -2 ppts/yr.

It is important to assess whether the weighing programme-derived estimates are reasonable, or wrong for some reason. If they are correct, it implies that the CBN is having a major impact.

Estimates from evaluation data.

An evaluation of the impact on child nutrition of the CBN component of the NNP was initiated by UNICEF in 2009, to cover tranches 2 and 3 of the CBN, launched in 2009 and 2010. Baseline surveys were conducted in July 2009 (tranche 2) and March 2010 (tranche 3). A midline survey for both tranches was done in September 2011. The design had 60 clusters of around 10 children each, and crucially the midline survey revisited the same clusters, drawing a new sample of children. No *ex ante* comparison groups were possible, but comparisons within the group of surveyed was feasible. More details are given in the Methods section.

The evaluation analysis determined that considerable and significant changes occurred in a number of maternal and child practices beneficial for child growth, including IYCF. This will be referred to later. For present purposes the child malnutrition results are the most useful.

⁹ What % of country is covered by CBN?

Stunting (and HAZ) were the most significant indicators associated with project implementation; underweight was similar but less robust, and wasting fluctuated uninterpretablely (at lower prevalences). The long-term without-program stunting trend was of -1.3 ppts/yr. Compared with this, the stunting change rates in tranches 2 and 3 were significantly higher, at -4.3 and -5.3 ppts/yr – an additional 3-4 ppts/yr over the long-term trend (which was already improving). Differences in VCHW activity were also used to assess program implementation in tranche 2, and a non-implementing group was defined in tranche 3, allowing comparisons that showed that these changes were plausibly attributable to programme activities. An example of this accelerated trend is shown in figure 2.13.

These results are consistent with the estimated decrease (in underweight, which is highly correlated with stunting) seen in the weighing programme data, and add plausibility to them. Moreover, the evaluation data indicated around 30% participation of children in the CBN programme woredas, also similar.

The improvement rates in stunting discussed above – generally increasing after 2005 – may indeed have included some acceleration due to the Community-based Nutrition programme.

Assessing change 2011-14

Three DHS surveys (2000, 05, 11) have been compared to estimate trends, initially in stunting, in children of 0-5 years. Since starting this work, data from a 2014 survey, known as ‘mini-DHS’, became available. Concern was being expressed that the 2014 data showed that the steady and rapid improvement had slowed down recently, at least in some areas.

We understand that the survey was carried out by the Central Statistical Authority, this time not in direct collaboration with Measure/DHS although using the same methods. We know that comparing surveys can give varying results from minor alterations in procedures, and the common rule is to compare surveys with others that are done by the same organization. Thus UNICEF MICS surveys are known to be not exactly comparable with DHS surveys, for example⁷. This problem is particularly difficult when comparing surveys quite close in time, where small differences need to be assessed. We undertook a limited analysis of the 2014 data to check comparability issues.

First, a comparison was available from previous work between DHS and the CSA Welfare Monitoring Surveys (WMS), reproduced in Figure 2.14. For stunting estimates, the WMS surveys report prevalences consistently 8 ppts higher than DHS. Underweight and wasting are nearly identical.

Second, the age heaping was found to be somewhat worse, see Methods, with an MAR of 0.23, compared to 0.151 for 2011 and 0.131 for 2000.

Third, a serious concern is that the measurement protocols call for children below 24 months to be measured lying, and at 24 months and over, standing. One result if this is not followed is that children are compared to the wrong standards; a second, probably more serious, is that this represents wrong age estimates – possibly with the ages recorded in the results being different

from that used to decide which way to measure. This issue is particularly problematic when trying to compare stunting prevalences between surveys. The device used in other analyses here of excluding mismeasured results gives different results in different surveys. The extent of this problem in the four surveys is shown in table 2.5, in the Methods section. In the 2000 survey (survey 1), for example, 16.2% of the 18-23 month children were measured standing when this should have been lying; and 17.3% of 24-29 month children were measured lying when they should have been standing. (The relevant cells are highlighted in the table.) These figures were 35.1% and 15.7% in 2005; 12.3% and 50.2% in 2011; and 30.2% and 13.6% in 2014. These are large errors, moreover different between surveys.

The effects of either removing or not removing these cases on the stunting prevalence estimates are shown in Figure 2.15, comparing the national lines with 'mg=1', meaning removing the erroneous cases, and 'mg= 0 or 1', including these. Unfortunately the interpretation on whether the improving trend in stunting continued in 2011-14 depends on the way in which this error is treated. Over the relatively short period of 2011-14, we probably cannot answer this question with any confidence from the stunting data alone.

One solution is to use underweight (WAZ <-2SDs), which at least only has the age errors to deal with, and which can be expected to closely follow stunting (unless wasting changes a lot). The results are shown in Figure 2.16, suggesting that the trend 2000-11 does continue to 2014. A further approach is to select the children ≥ 36 months, at which age the mismeasurement (lying not standing) is minor – 8% in the 2011 and 2014 surveys, less than 2% in the 2000 and 2005 ones, see Table 2.5 in the Methods section. The stunting trends for this ≥ 36 month group show a fairly steady drop 2000-14.

Affar and Somali are included separately since in these two regions, whichever way the calculation is done, a real deterioration in stunting is indicated from 2011-14, as shown in Figure 2.16. Affar and Somali have high wasting prevalences, but only make a small contribution to the national estimates having a small population. Their underweight increased 2011-14 (see Figure 2.16).

The effects of drought around 2011 can be seen persisting in certain age bands in the 2014 stunting data (see Figure 2.17): the fall in prevalence within age bands is regular up to 17 or 23 months, but from 24 to 35 months the stunting in the 2014 survey alone is increased. This may be a carry-over from droughts in 2011-12, with stunting in infancy persisting. However, on further investigation, this effect was neither common enough between regions nor large enough to account for the comparison problems, and was not pursued further at this time (but could be in future).

In sum, the national improvement rate 2000-14 in stunting was about 1.1 ppts/year, and in underweight 1.2 ppts/year. National results showing a slowdown 2011-14 cannot be confirmed, and could be spurious given the extent of length-height mismeasurement, likely associated with age misreporting as well. On balance, the stunting improvement rate probably was similar in 2011-14 to that 2000-2011, except in Affar and Somali.

Somali and Affar followed a different and worse trend, with recent increased stunting and wasting, and need to be treated separately. This will be the subject of further analysis.

Trends and differentials in child malnutrition in relation to key determinants.

Maternal education.

Almost every DHS survey in poor countries, and Ethiopia is no exception, show a strong association of maternal nutrition with child growth and nutritional status, when analysed cross-sectionally, and this has been interpreted as implying that improving maternal nutrition would be an important driver of improving child growth.

In a rapidly changing situation two associated benefits are thus likely: improving child nutrition *within* the children of better educated mothers; and an increased proportion of uneducated mothers becoming educated, thereby also decreasing child malnutrition prevalence because of this shift. In Ethiopia there is evidence that both these are indeed occurring. The trends are illustrated in Figure 2.18. The interpretation of these types of graphics, which show both population and prevalence, is described in further detail in the Methods section. The vertical axis is the prevalence, shown for children of educated and uneducated mothers for 2000 and 2011: 53% for uneducated in 2000, for example, falling to 38% in 2011. But at the same time the extent of education expanded; this is shown by the width of the bars: in 2000 82% of the mothers were uneducated, and this fell to 69% in 2011. The area of the bars is thus proportional to the numbers in each category.

Judging from the cross-sectional data, we expect that moving children-mothers from uneducated to educated will increase child nutritional status: in the figure some of the children in the wide left hand box for 2000 move to the narrower right hand box through time, and this exposure to better conditions associated with education benefits child growth. This takes some time, however, so we are seeing mixed effects of education itself, and of moving to a better-educated situation. In this case we might expect to see prevalence decrease faster in the educated group, but it doesn't – 46% to 33% is 13 pts, slightly less than the 15 pts for the uneducated group. (This finding is the same as in our results in Nepal analyses.) This implies that, despite the association seen cross-sectionally, maternal education is *not* an important driver of child growth improvement over the 11 years 2000-11. Exactly the same conundrum is encountered with poverty, as discussed in the next section.

This inconsistent finding results from comparing cross-sectional data analysis – far the most common – with analysis through time: DHS data is not very suitable for such through-time analyses, and they are less common. This can be investigated at a later time, using data comparable over time, such as the evaluation data referred to earlier; for now we have to leave it that while maternal education is important to nutrition, its exact role in driving improvements needs further study.

Poverty

Using relative poverty (wealth quintiles). An assessment of household wealth, based mainly on assets, is calculated as a wealth index in DHS survey data, and the population also split into fractions by their wealth index ranking, often as fifths, or quintiles. This index, and hence ranking, is calculated anew for each survey. Thus the quintiles are not directly comparable – they are not necessarily the same population groups – but they give a useful relative comparison both at-one-time, and with due caution across time, of correlates of *relative* wealth.

The prevalences of stunting by quintile and by survey are shown in figure 2.19, stunting-wealth quintiles}. The pattern in each survey means that there is virtually no reduction in stunting with increased wealth, or less poverty, until the top 20% -- the wealthiest group – is reached. The increase did begin to be felt in the second highest quintile by 2014, but the pattern remain mainly flat in the lowest 805 (or four quintiles).

The differences over time are larger than those among the lowest four quintiles. Moreover, all the quintiles are improving at about the same rate – the lines are dropping in parallel to each other. Thus something is happening that is improving child nutritional status that is more important than relative wealth. This could be absolute wealth – for example the lowest quintiles in figure 2.19 could be gaining assets over time, which would not be apparent from this figure, and which could account for some of the improvement. (Changes by estimated absolute poverty are discussed later.)

As there is some uncertainty about the HAZ measurements, it is useful to also investigate whether similar patterns are seen for weight-for-age. The results are shown in figure 2.20. In general these are similar, now with more of a definite slope of prevalence with wealth appearing by 2011; plus in all surveys improvement is seen by the fourth quintile.

This pattern of child malnutrition, with income (similar to wealth) has been well established for countries at different stages of development. The lack of slope between the poorest groups is found in the very poorest countries, and a slope develops with increased GNI. (A number of country examples are given in ⁸, based on extensive analyses later published by Gwatkin et al, ⁹) So these results from Ethiopia are typical of progress among the poorest countries. These results can be interpreted in terms of equity, although the results from simple ratios depend on how these are defined, especially as the relationships are non-linear. For example, a World Bank presentation compared trends of the three highest quintiles with that of the two lowest, and estimated the gap as increasing from 4.2 to 9.7 ppts, concluding this was increased inequity. On the other hand, we could note, for instance:

- The fall in prevalence for the lowest quintile, about 15 ppts, is similar to that of the highest (17 ppts)
- The gap between the lowest and the highest is 16 ppts in 2000 and 17 ppts in 2011
- The more striking aspect is the quite rapid parallel fall, suggesting all are benefitting to about the same amount
- Plus, this is the usual pattern of change with wealth, and signifies the start of rapid improvement.

So overall equity seems to be fairly stable. The World Bank poverty report raises further concerns specifically about the lowest decile (10%), and this was also investigated.

Did the bottom stunting decile worsen 2000-2011? The World Bank Poverty Report suggests that the consumption growth specifically for the lowest decile deteriorated (growth -2) 2000-5 to 2005-11 (see figure 2.21, imported).

We tested whether the bottom decile of HAZ¹⁰ was estimated to change between surveys in 2000, 2005, and 2011. For this, we needed to use the HAZ variable removing the restriction that excluded values <-5 HAZ, i.e. use the uncleaned version (cases below -5HAZ are considered to be mainly errors). Results are in table 23.11 below. They do not show that the stunting (as mean HAZ) for the lowest decile worsened 2000-2011, nor 2005-11 – in fact it substantially improved. (The prevalence will necessarily be 100%.)

This result is in line with our estimate that the nutritional status of children in the worst asset-poverty category improved as fast as those less poor in this period (see below).

However, using the HAZ from the 2014 survey, which (as explained elsewhere, is of doubtful comparability) the mean HAZ of the lowest decile has declined compared to 2011, although not compared to earlier years. The WAZ mean, however, for the lowest HAZ decile is not significantly different between 2011 and 2014. Asset-poverty (no improved housing, water, or sanitation) continued to decrease in the 2014 survey. Thus here too we do not find an increase in inequity.

Using an indicator of absolute poverty. While data so far seemed to show that improvement was general, it was important to know about the very poor, and specifically to see if those with no change in poverty improved like everyone else. We know that they do if the relative poverty remains unchanged, see above and figure 2.19. Ideally we want a group that in 2011 is a subset of a similar poor group in 2000. If we took the lowest end of the distribution of wealth or poverty, defined the same way in both years, these are likely to be comparable. A group with no assets at all in 2011 is likely to be a similar population group with no assets in 2000; and we assume that only a small proportion of those with assets in 2000 became asset-less in 2011. Asset variables were housing, water supply and toilet; adding education and health indicators made little difference to the group, so absence of the first three, in 2000 or 2011 was used to define a category of absolute poverty: no improved housing, nor water supply, nor toilet. It should be noted that these three variables account for most of the wealth index definitions.

The changes for this group are shown in figure 2.22, using a presentation similar to that for maternal education. The proportion of the population in no-asset-poverty fell greatly between 2000 and 2011, from 54% to 20%. It would be expected that this must have contributed to improving child nutrition. However, the rapid improvement was the same in both the no-asset-poverty group, and those better off. Stunting prevalence in *both* groups fell by 15 ppts, equivalent to 1.4 ppts/year. This is good news in that even the children in poorest households have benefitted as much as their better-off peers. But it leaves us, as with education, with some

¹⁰ This may not be exactly equivalent to consumption decile, but consumption-anthropometry data do not exist.

challenges in interpretation. Nonetheless, this is further evidence that ‘all ships rose on the rising tide’.

Finally, disaggregating the stunting trends by region, and distinguishing the no-assets group from those with some assets, gives the picture shown in figure 2.23. In almost every region the trends between poor and less poor are parallel (B-G has small sample size, but may be real).

Community effects

One possible reason that the improvement in child nutritional status occurred at similar rates in both the no-asset-poor, and/or in the children of mothers without education, might be that even the poorest families benefit when others in the community have improved living conditions; or similarly for education. This could be investigated by deriving variables (see table 2.12) to indicate the conditions of the cluster, then seeing if for example poorest households improved when they were in better than average clusters, and vice versa.

Poverty is defined for the present purposes as unimproved water and toilet and roofing; a cluster level dummy was created by deriving the cluster mean (from ‘aggregate’ routine for the household-level variable) and then dichotomizing this at the mean, for each survey; i.e. worse, > mean poverty for that survey. This, plus equivalent variables for other factors, are described in the table 2.12.

The calculations for *poverty* give the results shown in figure 2.24. These indicate that at both times (2000, 2011) the conditions where reduced poverty was associated with improved child growth were if BOTH the household AND the cluster (or community) were improved, meaning better than average. While it might be hoped that general improvement in the community would benefit even the poorest households, the evidence here seems to be in the opposite direction. In terms of improvement over the eleven year period between surveys, all four groups improved at about the same rates (by 13 – 15 percentage points (ppts)).

The results shown here are unweighted (for sampling differences), since they use regression and GLM, and we do not weight for multivariate analyses; in fact, the weighting makes little difference to the interpretation. Poverty results are not adjusted for covariates, as key ones are already contained within the poverty categorization.

Water supply results are shown in figure 2.25. These are adjusted for covariates (using GLM univariate routine; covariates are other poverty factors: education, sanitation, roofing; age; as they are for the other results in the figure 2.25, *mutatis mutandis*). In 2000, both cluster and household conditions were associated with improved growth. In 2011 the effect was only from improving household conditions, moreover only in the better clusters. Being in a better cluster with unimproved water, or in a worse cluster with improved water, was not associated with better growth. (Interactions shown are estimated by OLS regression, using *zhaz* as dependent variable, but results are given as prevalences.)

The results for *sanitation*, shown in figure 2.25, indicate that there was a big effect of improved household sanitation in 2000, irrespective of the cluster’s existing sanitation conditions. In 2011

the effect was less, and only in the better clusters. Sanitation improved more than other factors here over 2000-11, and it is possible that the lesser recent impact relates to diminishing returns as the worse-off areas are covered.

Education (figure 2.25) does show a substantial cluster effect, although here too the effect at household level is greater in the better clusters. The beneficial cluster effect, in both 2000 and 2011, is seen for uneducated households in better clusters – about 5 ppts in 2011 compared to worse clusters (compare points on LHS of figure 4 2011) – and the interaction of better education in better clusters brings this difference to 11 ppts in 2011 (compare points on RHS of figure 2.25 for 2011).

Finally, *roofing*, as a measure of SES as well as housing itself, shows no association with growth in 2000, and only in better clusters with better roofing in 2011 (figure 2.25). In other words, unfortunately, it looks like improvements at the community level only benefit child growth in better houses in better clusters; better housing in a worse cluster has no benefit, the stunting levels being the same in these as in poor houses in either better or worse clusters.

Child marriage.

More than 40% of the female population marries before 18 years of age, and 16% below 15 years¹⁰. Childbirth within one year of marriage is estimated as 9% for children <14 years, and 28% for 15-17 years. Thus a considerable proportion of the under-5 population is born to mothers who are still growing, and who are not yet ready to be mothers, according to most norms¹¹. Teenage pregnancy has been associated with lower birth weights, from IUGR and prematurity, as well as disadvantages for the mother in terms of her own biological development, and likely socio-economic status. Lower birth weights, if due to IUGR, could be a cause of stunting in childhood.

In Ethiopia, birth weights are not systematically recorded, and the direct association of mothers' young age with birth weight cannot be directly assessed. However, maternal age can be compared with infant and young child anthropometry from DHS data. The HAZ scores by 12 month child age for first born children, for mothers of 15-17 years, 18-19 years, and 20-24 years, are compared in table 2.13, and the same data are shown in figure 2.26. A significant difference of substantial size is seen in the 0-11 month children. However, this difference disappears by 12 months; and moreover loses significance ($p=0.13$) and size when mothers' education and height are controlled for (see table 2.14). In common with observations from other countries, this difference in growth reappears at around 36 months, in some countries persisting through 59 months. This latter growth disparity may be more due to social than biological factors.

In sum, the birth sizes of infants of mothers 15-19 years are reduced, probably due to a mix of prematurity and intra-uterine growth restriction (IUGR), which cannot be distinguished in these data. The HAZ of these children, unlike those of older mothers, does not further decline in the first year of life, so that by 12 months (24 months in some other countries) the HAZ of young mothers' babies is no longer different. The low birth size of young mothers' babies due to premature delivery is likely to converge with others, as the growth trajectory has already been

established. The loss of significance when controlling for maternal factors suggests that part of the low birth size is not because of the mothers' young age itself, but the associated low SES.

Maternal age of 17 years or less does contribute to increased stunting in infancy, but probably not directly in under-fives overall (see 'total' row in tables 2.13 and 2.15).

This is not to say that combatting teenage pregnancy should not be a high priority – it undoubtedly should and we have stressed that elsewhere – but that disadvantages to the mother herself remain an important reason; and the disadvantages to the child in most cases may be as much socio-economic as biological.

How do observed trends by vulnerable group relate to cross-sectional correlations?

Trends in stunting have been described overall and by vulnerable group. These tend to average about 15 ppts change between 2000 and 2011, and this trend is about the same in the worst off and better off groups. This is seen for the group with no maternal education vs that with some education, in figure 2.18, and for no-asset-poverty vs some assets in figure 2.22. However, factors such as poverty and maternal education are thought to be some of the main factors driving nutrition improvement, and this improvement seems to be taking place without them.

So the question arises: if improvement is happening anyway whether or not these driving factors change, are these factors actually contributing to the change? We will see in the next section that the rapid increase in income and consumption, across the board, could well account for much of the nutritional improvement. Put otherwise, does increased income and consumption account for *all* the nutritional improvement? Are we chasing red herrings by focusing on factors like maternal education in this context?

Clearly we do not have the data to look in depth into this. But we can ask whether the results are even compatible with a useful contribution to nutritional improvement of factors such as poverty reduction and maternal education. A simplified scenario based on no-assets-poverty is illustrated in figure 2.27. This draws on the format of figures 2.18 and 2.22.

The (over-simplified) key element of the calculation is to split the no-assets group in 2000 into those who will remain in this state of poverty in 2011 and those who will get some assets and be then included in the some-assets group in 2011 – called groups A and C respectively in the figure. Group A had no assets in 2000, and remained the same in 2011; group C had some assets in 2000 and is the same group in 2011. Group A, we observe from knowing the stunting prevalences by group in 2000 and 2011, improves from 58% stunting to 43%, i.e. 15 ppts. A similar estimate applies to group C, going from 53% to 38% also 15 ppts (by chance, it didn't have to be). But group B has gone from 58% to 38%, 20 ppts; we can ascribe 15 ppts to overall improving economic situation, and 5 ppts to the benefit of reduced poverty *in this group*.

Note that the 5 ppts ascribed to reduced poverty – which can come from the cross-sectional comparisons of the poverty to no-poverty groups in either 2000 or 2011 – only contributes to the defined changing group (B). At population level by this calculation, the 5 ppts is diluted to 5 $\times (34/100) = 1.7$ ppts. However, this does not take account (and cannot) of the contribution of

less poverty to the improvement in the groups that already have less poverty in 2000 – group C. If this group did not benefit from less poverty during 2000-11, its rate of improvement might have been slower.

These figures fit rather neatly together. We can do the calculation also for maternal education, referring to figure 2.18. Here the equivalent to group A is 69% of the population, and changes from 53% to 38% stunting prevalence, 15 ppts. Group C is 18% of the population, and changes from 46% to 33% prevalence, 13 ppts. Group B, 13% of the population which gains maternal education, changes from 53% to 33%, 20 ppts, of which 13 or 15 ppts (unsure which, and it doesn't really matter) can be ascribed to the underlying improvement; and 5 to 7 ppts from moving from the no-maternal-education group to the some-maternal-education group. Again, diluted to population level, this contribution of maternal education is 5 or 7 $\times$ (13/100) = 0.65 to 0.91 (say 0.7 to 0.9) ppts.

So the calculation seems to work for various factors.

In case there is dismay at the small population level contribution of cherished factors such as maternal education, we should note that the estimate from cross sectional data – from comparing those with and without the factor – will *always* be dependent on the number of people who actually change their group. Thus estimating that the effect of (e.g.) improved water supply – as we do in the next section – is (say) 10 ppts means a 10 ppt improvement for those whose water supply is improved; if this is half the population, the population impact will be 5 ppts.

The limitations of this calculation are many. For instance, the prevalences cited are means, and we have taken no account of the distributions. As noted, we cannot estimate the ongoing effect of (e.g.) improved maternal education in the group that has begun to receive this benefit. And there are many others. But probably the estimates of the effect of these factors is the lower bound – if anything the effect will be greater than assessed – especially as we cannot take into account the ongoing benefits.

Women's nutritional status.

The data from the 2000, 2005, and 2011 DHS's have been analyzed, in terms of trends in thinness (BMI<18.5) and anemia (Hb<12 g/dl) in non-pregnant women, and their distribution by wealth quintiles.

Trends.

The national prevalence of BMI <18.5 was estimated as 30% in 2000, and 26% in 2011, see figure 2.28. As for children, the 2005 data appeared out of line with the other two surveys, and are omitted for simplicity. The overall improvement was substantially less than for underweight in children. The trends by region are shown in figure 2.28 A&B. The nutrition of women in the N and NE – Tigray and Affar – actually worsened slightly in this period (in line with less improvement in children). Somali may have improved substantially, but cell sample sizes are <100 (unweighted) and the trend is thus less reliable (and the line is de-emphasized accordingly).

Otherwise most regions improved. However, in the NE in particular, underweight in women (low BMI) is around 40%, which is a high prevalence and indicates considerable need. One consequence is likely to be a lowering of birthweight due to malnutrition in pregnancy, perpetuating malnutrition between generations.

This intergenerational effect is a consequence also of the very high prevalences of anemia, shown in figure 2.29, especially in Affar and Somali, as well as Dire Dawa. The highland areas have rather low anemia prevalences, around 10-20%. The national estimate is 10%, improved from an estimated 16% in 2005. Attention to anemia is urgent in the lowland areas, and presumably is worsened as pastoralism becomes less viable hence animal product intake declines.

Relation to poverty.

Distributions of thinness and anemia by wealth quintile show some differences to child nutritional status. The slope of improved nutrition with increasing wealth, seen to be developing in child stunting, is only now beginning with respect to women's thinness. Figure 2.30 shows the relation of thinness (A) and anemia (B) with wealth for 2005 and 2011.

Thinness hardly changes with time, and there is no real slope until the last wealth quintile. Only the top 20% of women in terms of household wealth have increased weight over their poorer peers. For the 80%, changes in wealth are not translated into less thinness.

Anemia is interestingly different, with a slope with wealth being seen across the range, although again considerably larger for the top quintile. Further, the improvement over time affects all – this *could* be interpreted as improved equity, but that is probably too simplistic as we don't expect a linear response, certainly not at these low prevalences (you can't get below 0). But in any event, it is good news both that there seems to have been substantial improvement, and all wealth levels benefitted, on average.

Disaggregating by region, although stretching the sample in some cases (where cell sizes get <100, lines are de-emphasized), shows some differences from the average, see figure 2.31 and 2.32 A&B in each. Most striking perhaps is the considerable variation within quintile by region – these quintiles are comparable, as calculated for the country overall – so that location is seen to be more influential than poverty: Tigray and Affar, see for example figure 2.31 A, have nearly twice the prevalence of thinness at the same wealth quintiles as other regions. A similar story is seen with anemia, for Affar and probably Somali and Dire Dawa: anemia is much more related to location than to poverty. And the top quintile is always substantially better off.

(We could map the 2011 thinness and anemia results by zone.)

Estimates of trends in income, expenditure and food consumption, 2000-2014.

By region and time.

Estimates are given in the reports of the household income and expenditure surveys ¹²⁻¹⁴, based on the household surveys by the Central Statistics Agency (CSA). The 2012 Analytical report gives food consumption estimates as kcals/capita/day, by region comparing 2000, 2005, and 2011. These results are plotted in figure 2.33, for the rural and urban estimates combined.

The estimated average consumption increased from 2200 kcals/capita/day in 2000, to over 2400 kcals by 2011. The slope of increase was similar to that calculated by FAO for the Food Balance Sheets (FBS: shown in figure 2.33A), but otherwise the two estimates, from different sources, are substantially different (this is not unusual). The CSA survey estimates are likely to be more realistic, and show that the improvement was almost everywhere. However, the levels differ considerably between regions: SNNP, Gambela, B-G, Oromia, and Harari are above average, while Amhara, Affar and Somali are lower than average.

The consumption trends are likely to represent one important contributor to the rapid improvement in child nutritional status over 2000-11. Presumably as household consumption increases the food provided to children is likely to increase also. Evaluating how far the kcal increases lead to better dietary adequacy is not possible, as the household level kcal data would need to be compared to household food energy requirements, which are subject to much individual variation and are rarely if ever estimated in large scale budget surveys such as these. The increase of around 10% in kcal supply, between 2200 and 2450, could also be estimated with respect to the range in between clear inadequacy, and clear adequacy – say 1800 to 2800 – which gives 25% improvement. The distribution of food consumption by expenditure quintile (see figure 2.35 also discussed later) suggests that this may be a meaningful range – see difference between lowest and highest quintiles.

The dietary patterns reported from the CSA surveys however show little change 2005-10 (see ¹³ table 3.20 and ¹² table 35). The three highest consumed food groups were:

- cereals, 61.8% of total kcals in 2000, 58.6% in 2010
- potatoes, tubers and stems, 13.9% and 13.2%
- pulses, 6.9% and 6.7%
- moreover, oils and fats were only 2.3% in 2000, and 4.5% in 2010.

Thus dietary diversity remains low.

Given the numerous different factors involved, it would not be expected that much association would be seen between child malnutrition and kcal consumption, at regional level (which is the lowest level these can be matched at), and little is seen, as in figure 2.34. This also suggests questions on differences between, for example, Gambela and B-G – similar kcal levels but much different in stunting.

By household expenditure quintiles.

Food consumption and expenditure from the 2011 survey are plotted in figure 2.35, by expenditure quintile. The expenditure and kcal intakes increase substantially by quintile, the latter from less than 2000 kcals/capita/day to around 2900 kcals. The lower quintile level of 2000 kcals is likely to be too low, on average, to support health and moderate activity; almost certainly at this level discretionary activity is curtailed; and this represents significant deprivation. It is also consistent with high prevalences of child malnutrition. On the other hand, 2900 kcals, for the highest quintile, gives us an estimate of the likely amount of food energy that would be consumed if poverty was not a major constraint.

A different estimate of the adequacy of kcals can be made from the % of total expenditure that goes on food. As shown in figure 2.35, this was nearly 60% in 2005, 50% in 2011, hardly falling in the first 4 quintiles. This result suggests that food access became easier for all over time, as the % on food fell; but not until the richest quintile did it begin to take a lower proportion of expenditure, and by implication, income. Although inflation was significant, the relative price of food (FPI/CPI: see figure 2.36) increased by 20% (1 to 1.2), which could have been worse, and was evidently not enough to prevent more expenditure on non-food items as well as on food.

Expenditure and income.

Both CSA household survey data and annual estimates by the World Bank (in ‘purchasing power parity’) (figures 2.37 A and B) confirm large increases in expenditure/income over the 2000-14 period. The household estimates have been roughly adjusted to more nearly represent real income using the US\$:Birr exchange rates, as provided by the 2011 HICE report (table 24) ¹². They indicate about a doubling – 100% increase – in expenditure 2000-11. The Bank estimates almost a tripling, from 500 to 1400 (PPP\$¹¹) in this period, the take-off starting in 2005.

Together, the income and expenditure increases, and some lowering of the % spent on food, indicate a substantially improving nutritional situation, especially after 2005. The regional distribution of this achievement is indicated in figure 1, with food consumption increases apparent in all regions; there is not much crossover – the ranking of regions is similar in 2000 and 2011. Expenditure per capita by region is estimated in the HCE/CSA surveys. All regions except Harari, Addis Ababa and Dire Dawa (more urbanized) were similar in expenditures in both 2005 and 2011 – range reported as 1590-1920 in 2005, and 4070-5510 in 2011. The three richest had expenditures ranging from 2280-2580 in 2005, and 6375-9050 in 2011. This should explain some differences between the three more urban areas, and the other eight regions; but not within the eight poorer regions.

Data from the 2011 Welfare Monitoring Survey.

Some results complementary to those reported elsewhere here from DHS surveys are useful in the present context. Examples are included below as figure 2.38

¹¹ ‘Atlas’ method gives similar results

Nutrition and other transitions viewed over decades

The improvement rate of -1.4 ppts/yr in stunting prevalences is probably the highest in Africa at the time (see ⁴ table 23) and indeed one of the highest ever measured at national level in Africa. Comparing stunting trends with IMR and total fertility rates (TFR), see figure 2.39, the picture looks very like the middle stages of a demographic transition.

A standard picture of the demographic transition is shown in figure 2.40 for comparison. In Ethiopia, IMR started falling in the 1970's, more rapidly after 2000; the fertility rate averaged 7 children per woman in 1990, and since then has been falling to an estimated 4-5 children per woman at present; the IMR rate of change diverged from that of TFR around 2010. By the common definitions (figure 2.40) Ethiopia is starting the third stage of the transition, with birth rates falling, estimated by TFR. A possible projection from current trends, in figure 2.41, suggests that the demographic transition will be complete by about 2030, and that stunting would reach < 10% at that time.

This does not imply that the only factor driving stunting is TFR – although this helps. Rather, the same factors that are causing the demographic changes are also likely to cause nutritional ones – immunization coverage for example. History does show that usually as these transitions take hold, they tend to continue until complete, unless there are major changes in causal factors (climate change could be one). Nonetheless, the nutrition improvement is enhanced by specific nutrition programs, which almost always accompany the broader improvements. This has been seen primarily in Asia and Latin America (see WHO ENA), where the transitions started earlier and are more advanced, usually concurrently with national nutrition programs (e.g. Thailand), the effects of which are likely to improve the rate of stunting reduction.

At present in Ethiopia, the nutrition transition under way is mainly seen as reducing child malnutrition. The other side, a tendency towards overweight and non-communicable chronic diseases (NCCDs) coexisting with malnutrition, is probably only now beginning (note to look at trends in adult BMI), but needs to be kept in mind. Within this, the increased risk of chronic diseases in adult life linked to poor intra-uterine growth and low birth weight, with rapid environmental change (e.g. urbanization) makes the Ethiopian population particularly vulnerable to rapid future swings towards increased NCCDs.

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2. Nutrition analysis for guiding decisions on interventions

2.C. Risk factors: correlates of malnutrition as basis for extending interventions to further improve child nutrition.

Summary

Four risk areas were analysed, based in part on their connection to important programmes: water supply and sanitation; poverty; infant and young child feeding practices; and access to health services.

Poor water supply and sanitation were risks for child stunting, poor sanitation more so in the <24 month age group, and these associations were seen across most regions. Although these were independent effects, they were importantly modified by (i.e. interacted with) SES, such as maternal education, in an equity-negative direction, such that the higher SES group would be expected to benefit more from improved water or sanitation. For water supply in particular, this suggests that an educational component should be included with water supply improvement interventions so that the growth of children in worse-off households benefits. Unfortunately, further analysis shows that child stunting does not increase until the quality of water improves to the level of piped – those with well water are no better grown; thus water for about 75% of households needs to be improved – this is concerning, but worth knowing.

Within poverty groups no additional risk factors were identified (not very surprising since poverty definitions include many of these likely risk factors). However, the impact of improved SES, like education, can be extracted from within the overriding trend of poverty reduction.

Improving non-optimal infant and young child feeding (IYCF) practices at the appropriate ages provides a major opportunity for enhancing child growth, moreover one that is (unusually) equity-positive – the children worse-off SES households would benefit more. These cover breastfeeding, introduction of (semi-) solid foods, meal frequency, and dietary diversity. Of these, dietary diversity is particularly poor throughout Ethiopia, and would benefit from a broad approach, including agriculture, education, and other sectors (this is not to be taken to advocate home gardens, for which there is general evidence for scant impact). The directly relevant programme intervention is through the kebele workers (HDA) in the CBN, from whom messages more focused to appropriate ages could be effective; this has implications for training, supervision, etc.

Access to health services was assessed in relation to children above and below 24 months, although only feasible with indirect indicators (home delivery, ante-natal care; immunization, treatment of diarrhea). While there is no doubt that access to health services, and the success of extending the HEP, is of central importance for child growth, development and health, the associations with these factors in the data were limited (although in the expected directions), and seen mostly in the younger children. The policy implications are clear even without this, and this was not pursued further.

The associations of child stunting with risk factors was then used to define areas of risk, leading to the maps in the next section, and to suggesting gaps and opportunities in section 4.

Water and Sanitation (WASH)

Introduction

The research questions addressed here concern: are water/sanitation conditions associated with low HAZ and stunting in children? Are these effects modified by important contexts, like maternal education? Do they persist controlling for potential confounders, providing some evidence (together with other considerations, such as an understanding of mechanisms etc.) for their possible causality? Hence, what needs to be examined next for these purposes (e.g. size and extent of effects; disaggregate by area; distinguish by age bands; etc.)? These findings should help sharpen up definitions of need by area, age, education, poverty etc., to be then viewed against project activities that do and do not address these potential determinants, as discussed in the mapping section (3a) of this report.

Due to issues of miss-measured height or length for age (see methods section) this analysis refers to two age groups: (1) less than 24 months correctly measured lying; (2) 24 months and older correctly measured standing. The sample used is always indicated in the table heading.

National analysis: Water and sanitation (WASH) association with HAZ ¹²

Basic model associations

To assess the potential impact of poor sanitation on HAZ, the dummy variable for no toilet was used in linear regression analysis. In both age groups, having a poor water source was significantly associated with HAZ in the basic models (controlling for age and gender only) with coefficients of -0.22 and -0.23 in the younger and older groups respectively, as presented in table 2.15. Having no toilet was also associated with HAZ in the same models for both age groups, though to slightly less significance than water, with coefficients of -0.15 amongst the younger group and -0.10 in the older age group. The potential interaction of these two WASH variables was checked with regression and proved to be non-existent with p-values greater than 0.5 when controlling for age, gender, education, and poor roofing, as presented in table 2.16.

Ages less than 24 months

The full analysis of both WASH variables among the younger age group found stronger associations between no toilet and HAZ, while the association with water source diminished with important controlling variables added. Table 2.17 illustrates the results of regression models assessing the effect of both poor water and poor sanitation, represented by no toilet, on HAZ. Model 7 shows results controlling for age, gender, education, and housing quality (poor roofing), where both poor water source and no toilet

¹² From report 1, titled “Exploratory Analysis Write up 24 Sept_KSP JM”

have fairly minimal effects on HAZ. Here, poor water source has a slightly a more significant effect with a p-value of 0.067 compared to the p-value of 0.111 for no toilet (although the coefficient for poor water is smaller than no toilet: -0.101 compared to -0.155). There are no significant interactions in this model, though the interaction of no toilet and no education has not yet been removed.¹³ When mother's height is added¹⁴, the results change such that an interaction between no toilet and no education appears (model 8, $p=0.052$), and the effect of poor water source becomes very weak (model 8, coefficient=-0.049, $p=0.366$). When the interaction is removed, no toilet demonstrates a much stronger effect on HAZ than poor water source when mother's height is controlled for in this younger age group (model 9, no toilet $p=0.015$, poor water $p=0.334$).

To further understand the interaction between no toilet and no education, adjusted means of HAZ and prevalence are presented in table 2.18. The interaction is in the direction that the educated improve more than the uneducated when going from no toilet to any toilet. The mean HAZ and prevalence of stunting presented here are adjusted for all of the confounders in model 8 of table 2.17. The difference in HAZ between those with and without toilet is much greater among the educated ($p=0.0028$) compared to those with no education ($p=0.3537$) 2.18.¹⁵ This is illustrated in figure 2.42 where the adjusted HAZ by education and toilet shows a much greater improvement in HAZ among the educated, between those with and without a toilet, compared to the flatter line of the uneducated. Figure 2.43 shows this relationship in terms of stunting prevalence, however, the interaction is far less pronounced using the dichotomized stunting outcome variable, compared to the continuous HAZ variable.¹⁶

The addition of maternal height to the regression models had an interesting effect on the association of water and HAZ among this younger age group; maternal height essentially eliminated what appeared to be a somewhat robust correlation. This needs further investigation than what is presented here. One possible next step may be to select the agriculturalists and run the same models, excluding pastoralists and agro-pastoralists. Pastoralists generally have been shown to be taller in this part of Africa,¹ yet often have poor access to resources, such as drinking water source. The important measures of growth among children in these populations are more likely to be low weight-for-height, and possibly, low weight-for-age, considering the height differences from non-pastoralists. Including pastoralists here in the HAZ (height-for-age) analysis may be impacting the results.

¹³ See methods for further explanation of treatment of potentially significant interaction variables. In short, they are kept in subsequent models if the p-value remains <0.1 .

¹⁴ The effect of adding mother's height is quite substantial and not completely understood and probably needs further enquiry, but this should not change the conclusions presented here. The addition essentially reverses the importance of the two WASH variables, toilet and water, in this younger age group.

¹⁵ This is an equity-negative interaction: greater improvements in child growth are found among the educated.

¹⁶ This is fairly unusual: finding less significance of an interaction when using prevalence compared to HAZ, but the conclusions should be drawn from the results of the continuous variable (HAZ); prevalence is presented primarily for ease of interpretation.

Ages 24 months and older

In the older age group, 24 months and older, poor water source was much more important than no toilet in their effect on HAZ. Additionally, the effect of water interacted with no education on a similar manner to the interaction found between no toilet and no education in the younger group. The regression results are given in table 2.19; model 9 shows the strong interaction between poor water source and no education, which remained when all of the usual potential confounders, including mother's height were added to the model. Similarly, sanitation remained insignificant when relevant factors were controlled for in this group.

The adjusted mean HAZ and prevalence of stunting by education and water source further clarify the interaction. Table 2.20 presents means adjusted for the confounders included in model 9 of table 2.19. The difference in HAZ across water source is much greater among the educated ($p=0.000$) compared to the uneducated ($p=0.639$) 2.22.¹⁷ This is further illustrated in figure 2.44, where the diverged lines demonstrate the differential effect of water source on HAZ depending on education level. Figure 2.45 shows the same interaction in terms of stunting prevalence, where the difference between a good and poor water source is 11 percentage points (ppt's) among the educated compared to only 2 ppt's among the uneducated.

Conclusions of national analysis of WASH

In sum, poor water and sanitation are both associated with lower HAZ, but differences are found across age groups split at 2 years. Lack of sanitation, represented by no toilet facility, has a greater impact on HAZ of the children less than 2 years, while poor water source has a bigger effect on HAZ of children 2 years and older. Overall, the association with water among the older children appears stronger than that with sanitation among the younger children. In addition, education of the respondent interacts with both the water and sanitation variables in their effect on HAZ in the corresponding age groups; only the educated show real improvement across levels of good versus bad water and sanitation, illustrating equity-negative interactions. The interactions with education are such that little improvement in child malnutrition could be expected from improving the WASH environment without including some additional intervention to circumvent the finding that poor education and improved water supply/ toilet has little or no effect. This requires further (qualitative) research.

Regional analysis: Association of water source with HAZ among children 24 months and older¹⁸

Introduction

¹⁷ This is also an equity-negative interaction.

¹⁸ From report 2 titled "Source of Drinking Water by Region 10 29_final_KSP JM"

This section builds on the findings of the national-level WASH analysis. Having found the most significant association with HAZ to be with water source among the sample ages 24 months and older, this is the age group and association used here to evaluate WASH regionally. This analysis continues to select only those with the correct height measurement, standing for ages 24 months and older. This uses primarily the Ethiopia DHS 2011 children's dataset, though some descriptive analysis includes the 2000 and 2005 surveys (where indicated).

Summary of Results and Conclusions

Results: Source of drinking water was found to be associated with mean HAZ in the national sample when dichotomized into two categories: surface or rainwater (poor water supply), and other sources. This association persisted when controlling for potential confounders. Nearly half of the sample used here (≥ 24 months) has a poor water supply, among whom nearly half are stunted. There is a significant interactive effect between source of drinking water and education in the total sample, such that only the good education group is expected to benefit from an improved water supply.¹⁹

The association of child malnutrition with water supply is significant regionally in Affar, Oromiya, Benishangul-Gumuz, SNNP, Gambela and Dire Dawa. The interaction with education persists in Affar, Benishangul-Gumuz and SNNP; there are clear signs that a similar, but less strong, interactive relationship may exist in other regions. The exception is Amhara, where the association does not appear at all.

Conclusions: Improving the source of drinking water may lead to improvements in child malnutrition, however these improvements may be limited to the more educated due to the interactive effect of education and source of drinking water on HAZ. Therefore, it is advised that programs incorporate an educational component, based on safe water practices, in areas where the uneducated gain access to an improved water supply.

Descriptive statistics

About one-half of the national sample (≥ 24 months, measured standing) use surface or rainwater as their source of drinking water in 2012 table 2.21. This category is defined as having a poor water supply in this analysis. Children with a poor water supply have the lowest mean HAZ score at -1.8389 and the highest prevalence of stunting ($\text{HAZ} < -2$), at 48% (table 2.22). Similarly, one-half of these children have poor sanitation facilities, defined as having no toilet table 2.23, among whom, 46% are stunted (table 2.24).

Regional variations of water source and type of toilet facility exist in Ethiopia, along with regional differences in stunting and HAZ (tables 2.25, 2.26, and 2.27).

¹⁹ Equity-negative interaction.

Additional descriptive statistics with all 3 datasets ²⁰

Trends across survey year in type of water source used were assessed along with regional differences in water source; this time the entire age group of 0 to 59 months was used, selecting only those measured correctly for height or length based on their age, and the results were weighted. The results indicated a decline in the percentage of children in households using surface or rainwater as their source of drinking water, from 77.7% in 2000 to 55.9% in 2011 (table 2.28). The decrease corresponded to a 10 ppt increase in those using a public tap, or piped source outside of the residence, and a nearly 9 ppt increase in those using well water.

In the 2011 survey, the regions of Affar, Amhara, Oromiya, and SNNP all had more than 50% of children in the poor water category (table {SM WASH4 2}). In most regions, the highest prevalence of stunting was found in the poor water source category, among all water source categories, although, the well water category had the highest stunting prevalence in Affar, Amhara, and Benishangul-Gumuz (table {SM WASH4 3}). In Gambela and Addis Ababa, the public tap group had the highest stunting prevalence (although, Addis has only two categories of water source: piped – into residence, and public tap – piped out of residence). At the national level, the prevalence of stunting is very similar between those with well water (40.2%) and those with surface or rainwater (41.2%), as seen in figure 2.46. This seems to indicate that, despite any associations of surface or rainwater with HAZ, it may be necessary to improve the source of drinking water beyond the well water category (i.e. to public tap or better) in order to impact stunting. Regional prevalences of stunting by water category are also illustrated in figure 2.47, where similar results are found – surface/rainwater and well water are similarly bad-off in terms of stunting. Tigray children with surface/rainwater are the most stunted of all with a prevalence well above 50%.

The regionally and water-type disaggregated interaction between drinking water source and education on HAZ was looked into, by calculating the mean HAZ and stunting prevalence by education, within each type of drinking water by region (table 2.29). This revealed what the interaction really looks like (figure 2.48); one needs to get to public tap and some education before nutrition improves (note public tap is a step above well water, which was not included in “poor water” in the regression analyses). The interaction is much the same in Tigray, Amhara, Oromiya, and SNNP, and the difference in the level of improvement in the water supply by region is not large, so we can consider them together. The percent of children overall that have public tap or better and education is seen in figure 2.49; about 55% of the population have no education and unimproved water, and only about 13% have education and public tap or better (table 2.30).

For impact on stunting, these results imply that it is necessary to have at least a public tap, plus some education, before water supply contributes to improved growth. However, remember that the trends section found a number of other factors, some not identified, contribute to stunting reduction. The group defined as poorest (which included unimproved water) still improved from 2000 to 2011, and this did not change by adding no education to the definition.

²⁰ From document titled “Water by region_2.24.15”

The goal of the remainder of this analysis is to assess poor water supply, defined as surface or rainwater (not including well water) as the source of drinking water, as a potential determinant of HAZ within each region, highlighting regional differences from the national results.

Correlational analysis of association of poor water supply with HAZ by region

Having found an association between poor drinking water source and HAZ among children 2 years and older at the national level, the association is further explored at the regional level. The population used included children 24 months and older for whom height was measured standing; this population was segmented because of the issue of height/length mismeasurements by age described in the methods, and since this group showed the strongest association at the national level.

Regional Analysis

Table 2.31 summarizes the regional regression analyses of the effect of poor water supply on HAZ. The association of child malnutrition with water supply is significant regionally in Affar, Oromiya, Benishangul-Gumuz, SNNP, Gambela and Dire Dawa. The interaction with education is seen as substantial in Affar, Benishangul-Gumuz and SNNP, but there are clear signs that a similar but less strong interactive effect may exist in other regions. The regional exception of this association is Amhara, where it does not appear at all. In interpreting these results, note that if the interaction is significant then that is the term that counts (the non-interacted terms may or may not remain significant, due to collinearity, and their p-value's don't matter); the 2-way tables should be consulted to better understand the interactions (if there). Note also that in the 2-way tables the values are not adjusted for confounders, for ease of presentation (and calculation); these adjusted values can be calculated, if need be, from the regression models. The tables and figures for each region are included in the supplementary material, along with further explanatory text (see 2.C.SM text and tables {SM WASH2 6} through {SM WASH2 40}).

Summary of important interactions

Poor water supply, defined as those using surface or rainwater as their source of drinking water, seems to be a determinant of HAZ throughout many of the regions of Ethiopia. This relation is particularly strong in Oromiya, Gambela and Dire Dawa. While the effect of poor water supply on HAZ in Affar, Benishangul-Gumuz and SNNP is modified by educational level, such that improvements in water supply only results in decreased malnutrition among the educated. This effect modification may be true in other regions as well.

Conclusions of regional analysis of poor water

These results indicate the potential need for an educational component to correspond with programs aimed at improving water supply as an effort to reduce child malnutrition. The

regional analysis can also be used to specify difference in needs. The revelation of the high use of well water among the malnourished also indicates the need for improvements in water supply beyond the level of well water will be needed to impact child stunting in many regions.

Poverty (assets)

The association of poverty with poor child nutritional status is clear from the previous section on trends by poverty groups. Poverty can be quantified either in relative terms, such as by wealth quintiles which are redefined for every survey, or in absolute terms, such as by the ‘no-asset’ definition (no improved housing, or sanitation, or water) which is comparable between surveys. Both these have already been used in estimating trends. In this section we are investigating whether there are important (for policy) correlations over and above poverty, by relative or absolute poverty groups. Since many of the relevant variables are incorporated in the wealth quintile definition, and three in the ‘no-assets’ definition, the variables likely to be important are those unrelated (or with limited correlation) to those in the poverty definitions. Wealth quintiles are calculated by DHS using principal components analyses, leading to (literally) hundreds of variables selected, but with widely varying weights; water, housing, and sanitation are included, and given high weights.

A closely related issue is whether there are population groups specifically with worse child nutrition, over and above that expected from the poverty ranking. (The definition of the outlying groups would be the interacting variable.) This is first examined using the *relative poverty* definitions, which show the relative ranking of households within each survey; the 2000 and 2011 surveys are again the main focus, but 2005 and 2014 are included.

The frequency distribution of height-for-age mean (HAZ) for the lowest 40% in relative wealth terms, for all four surveys 2000-14, is shown in figure 2.50. This indicates a slight peak in 2000 around -4 to -5 HAZ, and a small shift downwards in 2011 at around HAZ -2.5. However these are not striking enough to try to track down. The means increasing through time have been seen before. Similar inferences come from the distributions for all quintiles, in Figure 2.51.

From the 2011 distributions by wealth quintile in Figure 2.52 it can be seen that not only do the means show very little response to increasing relative wealth until the richest quintile, but even the distributions within quintile show little change. Note that all quintiles do improve substantially through time – it is that this improvement is the same for all quintiles, and there is little slope until the richest quintile. There is a small excess of cases around HAZ -2.5 in the middle and richer quintiles. The data from 2000 are included here in Figure 2.53, so that comparison can be made with 2011. For example, the shift up in the means can be seen, without much change in the distributions.

So: it may be that certain population groups are worse off than would be expected from their relative poverty rank; however, if this was extensive we would expect to see more non-conformity within the distributions – relative poverty is accounting for a lot of the variation in HAZ. Nonetheless, it is worth looking for smaller highly vulnerable groups within poverty definitions. The sort of result that would show this is along the lines of

the hypothetical data in table 2.32, using remoteness as an example of a potentially interacting variable. If this was found it would suggest that particular priority be to the remotest and poorest, and conversely that this could be more effective in reducing malnutrition than a less targeted approach.

The variables tested were:

- Remoteness: the available variable was distance to water; this was categorized into seven categories, from 0 to >180 minutes
- Livelihood: the three categories (from the ecozone variables, summarized) were agricultural, agro-pastoral, and pastoral
- Ownership of livestock and land
- Urban-rural-migrant
- Access to health services: home or institutional delivery
- Maternal education (although this is incorporated in the wealth quintile definition, and is highly correlated with the ‘no-assets’ poverty definition ($p=0.000$))

The results using relative poverty, wealth quintiles, as well as *absolute* definition as ‘no-assets’ showed either that there were no substantial differences within different categories of independent variable, within poverty categories; or that the interaction was in the direction of having a minor effect among the poor, and a significant effect only in the less-poor group. In other words in the hypothetical table 2.32 the horizontal differences were in the better group, not the worse. Similar results were found either with wealth quintiles or ‘no-assets’ poverty.

An example of the interaction in the direction found is in figures 2.54 and 2.55. The association of improved education with better child nutrition is only in the less poor group. Indeed, even the less poor group is no better than the poorest, without maternal education, both poverty groups showing similar levels of wasting or stunting.

As discussed earlier, the % of the population estimated as poor in absolute terms was reduced from (65%) to 16% between 2000 and 2011, and this is really the larger story. Poverty is highly associated with child malnutrition – and this is not confounded by biological factors, the coefficients remaining highly significant controlling for age, gender, mother’s height – and within poverty groups other factors remain important. However their effect does not appear to be exacerbated by poverty; on the contrary, this effect is sometimes greater in the non-poor groups.

The policy implication is that reducing poverty brings substantial benefit to child nutrition; other factors listed above, such as access to health services or maternal education, need to be improved at the same time, for everyone.

Infant and Young Child Feeding

Exploratory Analysis: Minimum Dietary Diversity and HAZ (2011 data)

Introduction

Infant and young child feeding (IYCF) practices influence the nutritional status of children and are therefore included in this correlational analysis of child nutritional status in Ethiopia. The WHO definitions of IYCF practices lent guidance in choosing how to examine these practices. Minimum dietary diversity was chosen as the first IYCF indicator to explore due to the significant improvements of this indicator found by White and Mason during the evaluation of the Community Based Nutrition program in Ethiopia.² Disha et al. also found this indicator to be associated with HAZ in the 2005 Ethiopia DHS data.³

Summary of Results

Minimum dietary diversity, defined as consumption of foods from at least three different food groups, is positively associated with mean height-for-age (HAZ) in breastfeeding children ages 6 to 23 months in Ethiopia. This association is strongest in 18 to 20 month old children. There are regional variations of this association. Minimum dietary diversity does not appear to be a strong predictor of HAZ in the regions of Oromiya, SNNP, Benishangul-Gumuz, and Gambela. In addition, very few children ages 6 to 23 months receive foods from at least three food groups in Affar, Somali and Addis-Ababa, suggesting that an alternative child-feeding indicator should be assessed in these regions. In the regional group of Tigray, Amhara, Dire Dawa and Addis-Ababa, better dietary diversity is significantly associated with higher HAZ, similar to the national level. In conclusion, improvements in child stunting would be expected from increased dietary diversity in the larger regions of Tigray and Amhara, and possibly in the smaller regions of Harari and Dire Dawa. However, dietary diversity remains a challenge across all regions in Ethiopia, with very low percentages of children consuming even a modestly diverse diet of three or more food groups.

National Analysis

Notes on the impact of breastfeeding status on HAZ and stunting

The recommendation of analyzing minimum dietary diversity separately for breastfeeding and non-breastfeeding children was followed for most of this analysis. However, since the numbers of non-breastfed children in the sample of 6 to 23 month age group was small, the effect of breastfeeding status on the association between minimum dietary diversity and HAZ was first explored. Table 2.33 shows a higher percentage of children receive a more diverse diet among the non-breastfed group, as is expected, since breastmilk is not counted as a food group in summing up the dietary diversity score.

Since complementary feeding varies significantly by age, it is also advised to assess this indicator by smaller age bands, within the 6 to 23 month group. Table 2.34 displays mean HAZ by category of 'three+ foods' in 3-month age bands among the combined breastfeeding and non-breastfeeding group. From this initial assessment, the 18 to 20 month age band shows the strongest bivariate association between 'three+ foods' and HAZ, with a difference of 7.6 percentage points in stunting prevalence between the groups with and without 'three+ foods' (change in HAZ $p=0.003$), so this age group was chosen to explore the impact of breastfeeding status on this association.

Consumption of three or more food groups is associated with higher mean HAZ amongst children ages 18 to 20 months when controlling for potential confounders of age, gender, education, breastfeeding status, and roofing quality (table 2.35). The breastfeeding variable is significantly associated with a lower HAZ throughout all of the models, as seen by the coefficient of -0.588 in the final model with all of the variables included. This seems counterintuitive since it reveals that non-breastfed children are actually larger, but this may be explained by the mother choosing to continue breastfeeding based on the size and/or health status of her child, especially in the age groups around the time when weaning occurs. If the mother feels her child is large and healthy, she may discontinue breastfeeding sooner than if she felt her child was small or sick. Marquis et al. examined this relationship in depth in Peruvian children where they found that the negative association of breastfeeding with child stunting was an example of reverse causality, such that inadequate growth and poor health resulted in increased or continued breastfeeding by the mother.⁴

Since this strong, counterintuitive association was found, the remainder of the analysis of minimum dietary diversity, represented as three or more foods, is done on breastfed and non-breastfed children separately. This is the appropriate method for this IYCF practice anyway, since breastmilk is not counted in any of the food groups that comprise this indicator, so it is possible and likely that the percent of children receiving three or more foods among breastfed children is lower than among non-breastfed children, as found in this sample (table 2.33).

Non-breastfeeding group

Looking into further age breakdowns of the percent of children receiving three or more foods by breastfeeding status reveals very small samples among non-breastfed children, especially in those less than 12 months (table 2.36). When stunting is assessed by category of minimum dietary diversity and age group, the sample sizes become even smaller as can be seen in table 2.37, so the non-breastfed group is analyzed at the aggregate 6 to 23 month age. Among this group, there appears to be no association between HAZ and minimum dietary diversity, as represented by the bivariate p -value of 0.462 (model 1, table 2.38). When age and gender are included in the model as potential confounders the lack of association remains ($p=0.855$, model 2, table 2.38).

Minimum dietary diversity cannot be assessed as a potential determinant of stunting in non-breastfed children older than 23 months due to inadequate sample sizes ($n=19$ for

non-breastfeeding 24 to 36 months, non-missing on ‘three+ foods’, table 2.37). This IYCF indicator is meant to assess feeding practices in children 6 to 23 months, so the survey questions that comprise minimum dietary diversity may not have been asked of children greater than 23 months since it appears that a large percentage of children in this age band have missing responses for these items.

Currently breastfeeding group

The bivariate relationship between dietary diversity and HAZ in breastfeeding children varies by age group, and is not associated in the aggregate 6 to 23 month age group without controlling for potential confounders (p-value=0.492, table 2.39). Some relationship seems likely however, since the prevalence of stunting is higher among those not receiving three or more foods across all age groups. Given the large variations of this indicator across ages, the association was checked with linear regression analysis controlling for potential confounders including age. Table 2.40 displays results of the full regression analysis assessing three or more foods as a predictor of HAZ when controlling for potential confounders and accounting for possible interactions. Age appears to have a strong negative confounding effect; there is a clear association once age is controlled for as seen in the differences between models 1 and 2 (p=0.492 in model 1 and p=0.000 in model 2). The coefficient for HAZ between those with and without three or more foods goes from 0.063 unadjusted, to 0.352 when adjusted for age and gender.

This negative confounding elucidates the importance of adjusting for age to see the true effect of dietary diversity on HAZ and stunting, especially if the sample includes a broad age range. The association with HAZ remains strong when the potential confounders of education, roofing, toilet and water supply are added to the model (p=0.005, model 9). No interactions appear relevant. Adding mother’s height to the model further tested the strength of this association. This did not result in any significant change in the effect of dietary diversity on HAZ (model 10). Note that poor water supply is not associated with HAZ in this analysis (p=0.288, model 9). The WASH chapter explains the stronger association between poor water supply and HAZ was found in children greater than 23 months, not the age group used here.

Age group analysis: currently breastfeeding

The association between HAZ and three or more foods among currently breastfeeding children is further assessed by disaggregated 3-month age bands in order to determine the true effects within age groups when controlling potential confounders. Toilet and water supply were not included in the age specific analyses since these variables did not have a significant effect on the coefficient of three or more foods in the 6 to 23 month age group (see table 2.40). The results of the regression analysis for each age group of three or more foods as a predictor of HAZ with age, gender, no education and poor roofing in the models, along with any important interactions, can be seen in table 2.41. Detailed models for each age group are found in the supplementary material for chapter IYCF. The 18 to 20 month age band is the only group with a significant association in the final model (p=0.011), and the overall association (6 to 23 months) is driven by the 15 to 20 month

age group. This indicates that dietary diversity may be more important in the older age groups.

Regional Analysis

Based on the percentages of children receiving three or more foods in each region, along with other similarities, regions were grouped for further analysis. The sample sizes within some regions were inadequate for individual analysis of dietary diversity. Table 2.42 shows the prevalence of children receiving three or more food groups across the regions. The highest prevalence is found in Gambela at 21.6% and the lowest consumption of three or more foods occurs in Somali at only 4.6%. Affar also has a very low percentage of children with improved dietary diversity at only 7.1% consuming three or more foods. Table 2.43 illustrates the regional groups used for exploring the association of dietary diversity and HAZ at sub-national levels. A secondary grouping was also used as depicted in the right hand column.

All regional analyses use the entire 6 to 23 month age group. Although the age specific analysis indicated the most significant association of three or more foods with HAZ occurs in 18 to 20 month olds (table 2.39), the concept of dietary diversity is important starting at 6 months. The association was also strong in the entire 6 to 23 month group at the national level (table 2.40), so if the association is relevant regionally, it should appear in this larger group. This also allows for a more adequate sample size to investigate the relationship within regional groups.

The bivariate associations between HAZ and consumption of at least three food groups is found in table 2.44, where there appears to be no significant effect. However, as age was found to be a negative confounder at the national level in the 6 to 23 month age group, age must be adjusted for here. Table 2.45 displays the regional mean HAZ by category of three or more foods, adjusted for age and gender.

The associations are further explored via regression analysis. The association of HAZ and three or more foods in Amhara remains significant at $p=0.080$ (table 2.46) when age, gender, education and roofing are added to the model, with an effect size of 0.482 in mean difference of HAZ. Affar and Somali, were grouped together due to very low prevalences of children receiving three or more foods at 4 and 7% (table 2.42). As a result, the sample size in the three or more foods category was too small to be useful, and the non-significant regression results are not a clear indicator of what is happening in the region. A different IYCF indicator should likely be used to assess the impact of feeding practices on child malnutrition in Affar and Somali. Addis Ababa also had too small of a sample size to accurately assess the impact of dietary diversity on HAZ, despite a higher prevalence of nearly 20% (table 2.42). The regression results in Addis are also non-significant, likely due to this small sample size. The larger group of Oromiya, SNNP, Benishangul-Gumuz, and Gambela displayed adequate sample sizes with their prevalences of children receiving three or more foods ranging from 18.6 to 21.6%. No association was found in this group when the covariates were added, with an adjusted effect size of 0.153 (table 2.46).

To further discover where the association found at the national level is occurring regionally, the smaller groups were aggregated together to compare against the larger, non-associative group of Oromiya, SNNP, Benishangul-Gumuz and Gambela. Affar and Somali were excluded, as they are significantly different in terms of dietary diversity and other factors. The new group consisting of Tigray, Amhara, Addis Ababa, Harari and Dire Dawa and is assessed with the full regression analysis. Here, an association similar to the national level was found, with an adjusted difference in mean HAZ of 0.388 ($p=0.004$, table 2.47). This finding indicates an expected increase in HAZ may result from improved feeding practices, by means of dietary diversity, in the regions of Tigray, Amhara, Addis Ababa, Harari, and Dire Dawa.

Child Stunting and Infant and Young Child feeding Practices in Ethiopia: EDHS 2000, 2005 and 2011.

Introduction and summary of conclusions

Upon completion of the exploratory analysis of minimum dietary diversity with the 2011 data only, it was decided to dive deeper into IYCF practices by looking at more indicators and assessing changes from 2000 to 2011. Using the merged dataset with all 3 surveys, the remaining sections of this chapter present descriptive statistics and bivariate associations with HAZ of several additional IYCF indicators. Correlational analyses using regression techniques are included where the indicator presents a potential association in the bivariate form, and when sample size allows. The regression analyses use the 2011 data only. Sample size is an issue for several IYCF indicators due to the narrow age groups to which the practices apply (ex. timely introduction of complementary foods is measured among 6 to 8 month olds). As a result, regional analysis is often limited to simply descriptive statistics since the sample are small (the method of greying out cells with $n<30$ is followed throughout). The exploratory analysis of minimum dietary diversity (first section of this chapter) goes into a more detailed regional analysis of IYCF practice.

The WHO IYCF indicators used here include:

1. Early initiation of breastfeeding
2. Exclusive breastfeeding under six months
3. Continued breastfeeding at one year
4. Introduction of solid, semi-solid, and soft foods
5. Minimum meal frequency
6. Minimum dietary diversity
7. Minimum acceptable diet
8. Consumption of iron-rich or iron-fortified foods

Some of the formal definitions of these eight indicators, given by WHO, were slightly altered in order to be useful across the all three datasets (2000, 2005, and 2011). The methods section includes a detailed table of the original definitions, applicable

population, and how/if the definition was altered table 2.1B. Additionally, the methods table of independent variables created, includes all of the IYCF variables used here and their derivations (table 2.1A).

To give an overview of how improvements in stunting may result from interventions fostering better IYCF practices, the effects on HAZ by 3-month age band (adjusted for potential confounders) of 5 important practices are summarized in table 2.48. The adjusted effects (third row in each) are then transformed into approximate stunting prevalences, and the results given in figures 2.56 A and B. This figure shows the expected improvements in percentage points (ppts) of stunting from correcting the inappropriate practice in the group with this; thus the improvement in that group is shown in figure 2.56 A and, taking into account the % of the population that would correct this practice, the overall effect on the population prevalence (figure 2.56 B).

The results suggest that the timing of possible interventions is much as would be expected:

- ensuring timely introduction of solid foods is needed at 6 months and would have a substantial effect up to 1 year, reducing stunting by up to 10 ppts
- increasing meal frequency should have an impact from 6-14 months, reducing stunting by around 10 ppts also – these effect sizes would not necessarily be cumulative, either across ages or practices
- then, in the second year of life, improving dietary diversity becomes the priority, again with potential for around 10 ppts improvement in stunting prevalence
- early initiation of breastfeeding has a detectable association with better HAZ at 0-2 months, and is important for this and other reasons.

Several important interactions are in the direction that the less educated groups would benefit more from intervention, thus giving likely positive impact on equity.²¹

Summary of results

Infant and young child feeding (IYCF) practices are examined from the 2000, 2005 and 2011 Ethiopia DHS Children's recode datasets. The 2005 data included a much smaller sample size than the 2000 and 2011, often with very different prevalence estimates compared to the other years. As a result, change in IYCF practices is based on the change from 2000 to 2011.

Early initiation of breastfeeding At the national level there has been an increase in early initiation of breastfeeding, defined as the child being put to the breast within one hour of birth. The 2011 data shows a higher mean HAZ among those who initiated breastfeeding early, for the first 2 months of life. This was not found in the 2000 data. Further analysis indicates this practice is associated with better child growth for the first

²¹ The equity-positive interactions found in this section are unusual, and dissimilar from interactions found elsewhere (i.e. WASH).

two months of life and thereafter, it seems, other factors become more important indicators of HAZ.

Exclusive breastfeeding under six months There has been a slight decrease in children 0 to 5 months who are exclusively breastfed, with the concerning issue that the largest decrease was found in the youngest, 0 to 2 month olds. The mean HAZ by breastfeeding status does not appear to follow any expected directions, which is likely due to mothers prolonging exclusive breastfeeding of a smaller or sicker child, and deciding when to introduce complementary foods based on the child's size rather than age. This phenomenon makes it difficult to assess possible associations between breastfeeding status and child malnutrition (this is explained further in the previous section of this chapter titled: *Notes on the impact of breastfeeding status on HAZ and stunting*).

Continued breastfeeding at one year Continued breastfeeding at one year has remained very high throughout all survey years, with 95% or more children ages 12 to 15 months currently breastfeeding.

Introduction of solid, semi-solid, and soft foods The percent of children receiving solid, semi-solid or soft foods at the recommended age of 6 to 8 months has increased by more than 12 percentage points from 2000 to 2011. This appears to be most important around 6 to 11 months, when the child should begin consuming complementary foods. There is an interactive effect on HAZ between introduction of solid, semi-solid or soft foods and education such that those who are uneducated seem to benefit more from achieving the timely introduction of complementary foods compared to the educated group.

Minimum meal frequency The percent of children receiving the minimum number of recommended meal feedings has increased from 2000 to 2011. The mean HAZ is higher amongst those meeting the minimum meal frequency recommendations across nearly all age groups in both the 2000 and 2011 data, up until the 21 to 23 month age group. Further analysis shows this indicator to be associated with HAZ in the younger 6 to 11 month ages, similar to the association found with consumption of solid, semi-solid and soft foods indicator. The same interaction with education was also found with minimum meal frequency in 6 to 8 month olds, reaffirming the interaction found with complementary foods. By 12 months, the importance of meal frequency in relation to child nutrition seems to diminish.

Minimum dietary diversity The percentage of children receiving a dietary diversity of either 3 or more, or 4 or more food groups has *decreased* amongst both breastfed and non-breastfed children from 2000 to 2011.²² Those with less dietary diversity tend to have a lower HAZ, although this varies by age group. This association was analyzed in depth in the 2011 data in the previous section of this chapter. The importance of dietary diversity as a predictor of HAZ seems to come in the older age groups, with the strongest associations found among 15 to 17 and 18 to 20 month olds.

²² This is not good news. Dietary diversity is not only a major problem for child feeding throughout the country, but is getting worse.

Minimum acceptable diet The percentage of children meeting the recommended minimum acceptable diet for their age and breastfeeding status has *decreased* from 2000 to 2011 – due to the decrease in dietary diversity – since minimum acceptable diet is a combination of meal frequency and dietary diversity.

Consumption of iron-rich or iron-fortified foods The consumption of iron-rich foods has increased slightly from 2000 to 2011, but this trend varies significantly across regions.

Cumulative child feeding patterns Cumulative child feeding status by age group is presented nationally for each survey year and for regional groups in the 2011 data. These graphs can further elucidate the child-feeding pattern over time. These are included in the supplementary material for the IYCF chapter.

Results

Early initiation of breastfeeding

Early initiation of breastfeeding is the only indicator that is measured using the respondent's recall beyond the 24 hours preceding the survey. As a result, the responses may be particularly affected by recall bias, especially in the older age groups, as the mother must recall further back in time.

The percent of children born in the last 24 months who were put to the breast within one hour of birth has increased nationally from 2000 to 2011 by 4 percentage points, from 49% to 53% (table 2.49). Although the indicator appears to have improved significantly from 2000 to 2005 (48.9% to 67.4%), and then decreased again from 2005 to 2011 (67.4% to 52.9%), the 2005 survey had a much smaller sample size and has demonstrated results that are similarly out of range throughout the data across all indicators, making it difficult to compare the 2005 to the 2000 and 2011 data. Therefore, the trends in IYCF practices have been assessed primarily with the 2000 and 2011 surveys, often omitting the 2005 results for clarity. All correlational analyses reported here use the 2011 data.

Most regions followed a similar pattern of improvement in early initiation of breastfeeding from 2000 to 2011 except for Oromiya, Somali, and Benishangul-Gumuz, which saw declines in this indicator during the time period (table 2.49).

Mean HAZ does not appear to vary consistently based on early initiation of breastfeeding across age groups within all 3 surveys (table 2.50). The 2011 data shows a possible positive association of initiating breastfeeding within one hour with HAZ, until about 8 months, when mean HAZ amongst early and late breastfeeding initiation merges to the same level (Fig. 2.57); a significant difference ($p < 0.001$) is found in only the youngest age group of 0 to 2 month olds (table 2.50).

Further analysis shows a positive effect on HAZ from early initiation of breastfeeding in the youngest group of 0 to 2 month olds, when controlling for covariates of age, gender, housing quality, education status and mother's height (table 2.51, model 7). There is an interaction of early initiation of breastfeeding with age, even within this small age band. Table 2.52, model 7, shows the same interaction between early initiation of breastfeeding and age in 3 to 5 month olds. This means that *within* the 0-2 and 3-5 month age groups, there is a significant difference in the association of HAZ with early initiation of breastfeeding depending on age (as also seen in Fig. 2.57). More important, the association of HAZ with early breastfeeding is established in the 0-2 month group controlling for potential confounders (table 2.51), and is less clear in the 3-5 month group (table 2.52).

Mean adjusted HAZ by specific age in months and category of early initiation of breastfeeding is presented in table 2.53 to assess these relationships. The association is substantial (a difference of about 0.4 HAZ, equivalent to about 10 ppts change in stunting) and significant ($p < 0.05$) at ages 1 and 3 months; the result at 3 months (NS, $p = 0.7$) is unexplained. After the first two months of life, the benefit on growth from initiating breastfeeding within one hour of birth diminishes. The results are also shown in fig. 2.58, from the data in table 2.53, which make sense in that the effect declines with age.

Table 2.51 is the first of a series of similar presentations of regression results, so it may be worth a pause to walk through it. Model 1 always gives the bivariate association; this may differ somewhat from earlier estimates by tabulation, as the regressions are un-weighted. In this case, the coefficient of 0.360 corresponds to the difference in table 2.50, 0-2 month group, between HAZ of 0.2146 and -0.3767 ($= 0.5913$), which are the population weighted estimates; we can also check, as $n = 432$ here and in the regression model (matching the un-weighted n given in table 2.50). Model 2 checks for the effects of age and sex on the early initiation coefficient – in some cases the effect of controlling for age is substantial, usually *increasing* the size and significance of the coefficient (see e.g. table 2.61); this is unusual and important, as it means we tend to uncover effects when removing age; put otherwise, some associations do not show up by tabulation, due to age confounding (in an unusual direction). In model 3 the interaction term between the factor under study (early initiation here) and age is tested, and kept in if $p < 0.1$. We then check for possible confounding in subsequent models, here with roofing and education. Since education is quite often interactive, and important if it is, this is usually tested (as in model 5 here), and again dropped if $p > 0.1$. Where there are significant interactions, the model with these is used for drawing conclusions (e.g. model 7 here). However, as in table 2.48, we sometimes need to have comparable coefficients, and the interaction term in the model affects the coefficient for the factor under study (early initiation here); thus as an approximation, the coefficient from the model omitting the interaction is used for this purpose, here model 8, coefficient = 0.221.

Exclusive breastfeeding under six months

The percentage of children ages 0 to 5 months who are fed exclusively breastmilk has decreased slightly from 54.2% in 2000 to 51.4% in 2011 (table 2.54). The decrease was found across all 2-month age groups, including in the youngest 0 to 1 month age group, which experienced the most significant decrease of almost 10 percentage points during the time. The low prevalences, averaging around 50% and falling, in exclusive breastfeeding among 0 to 5 month olds is a problem that needs to be addressed. It is also in line with a trend towards earlier introduction of other liquids and complementary foods, as discussed in the section on introduction of solid foods below.

This indicator is difficult to assess regionally since it is measured amongst only a small age band of all children included in the surveys. As a result, some of the less populated regions have a very small sample size of 0 to 5 month olds from which this indicator is determined, resulting in weak prevalence estimates. The regional estimates of exclusive breastfeeding by survey year can be seen in table 2.54; some regions experienced increases and some experienced decreases in the prevalence of exclusive breastfeeding amongst 0 to 5 month olds. SNNP was the only region to have a significant increase in the indicator going from 40.8% in 2000 to 51.2% in 2011. Oromiya was the only region with a significant decline in the prevalence of exclusive breastfeeding.

The difficulty of assessing the impact of exclusive breastfeeding on growth is due to the nearly always lower HAZ in the exclusively breastfed group (tables 2.55). In the ages less than 5 months there exists the spurious relationship of lower HAZ with exclusive breastfeeding due likely to mother's introducing other foods to her baby if they appear bigger and healthier (as explained previously). Above 5 months, those who are still fed exclusively breastmilk are worse off as they are not receiving the complementary foods needed for optimal growth (figure 2.59). This is further illustrated in table 2.56 by the negative correlation between exclusive breastfeeding and HAZ at every age group within each survey year.

Since there is no way in these datasets to allow for this counter-intuitive and presumably spurious association of exclusive breastfeeding with poorer growth, these results are not explored further at this time.

Continued breastfeeding at one year

Continued breastfeeding at one year has remained high throughout all three surveys. Measured as the percentage currently breastfeeding among 12 to 15 month olds, the indicator has gone from 94.9% in 2000 to 96.4% in 2011 (table 2.57).

This indicator is also difficult to estimate in some regions due to the narrow age band used, resulting in some inadequately sized samples. As such, the statistics presented should be interpreted cautiously. Most regions have had 90% or higher percentages of children breastfeeding at 12 to 15 months in 2000 and 2011 (table 2.57).

This appears undiluted good news: the program implication is to encourage continuation of current breastfeeding practices for children 6-24 months.

Affar, Somali and Addis Ababa are the exceptions with lower prevalences, the lowest being 55.6% in Somali in 2000, which increased to 76.2% by 2011 (table 2.57).

Introduction of solid, semi-solid and soft foods

The timely introduction of complementary foods, measured as the percentage of children ages 6 to 8 months receiving solid, semi-solid or soft foods, has increased from 36.1% in 2000 to 48.5% in 2011 (table 2.59). Amongst 3 to 5 month olds, the percentage receiving complementary foods has also risen significantly from 8.5% to 17.6% from 2000 to 2011 (table 2.59). This corresponds with the decline in exclusive breastfeeding amongst this age group, and the trend towards earlier introduction of other foods. Despite the improvements through time, there remain more than half of children not receiving complementary foods at the suggested introductory age of 6 to 8 months. Even at 12 to 14 months of age, nearly 20% of children were not receiving solid, semi-solid or soft foods in 2011.

This indicator is similarly difficult to assess regionally due to the small sample sizes found within the narrow 6 to 8 month old age band. Most regions have followed the national trend with increases in the percentage of children 6 to 8 months old receiving solid, semi-solid or soft foods from 2000 to 2011 with some exceptions (table 2.59).

Some regions have lower prevalences of this indicator on average. In 2011, Affar, Amhara, Somali and Dire Dawa all had prevalences below 40% (table 2.59), which represents a problem and nutritional risk. Those regions with large pastoral populations – notably Affar and Somali – have much lower rates of introduction of solid foods. The dietary practices differ in these populations from those of other livelihoods, agricultural primarily in the other regions. Moreover, pastoralist children in general show *faster* height growth than others (Fig 2),¹ and stunting tends to be less in these regions. So, this low rate of introduction of solid foods is apparently not so much of a risk in these populations. (This issue needs further elaboration in subsequent papers.)

Mean HAZ is higher among those receiving solid, semi-solid or soft foods in all three survey years among 6 to 8 and 9 to 11 month olds, with the differences being significant in 2011 (table 2.60). As age increases, more children are receiving the appropriate complementary foods and thus this indicator becomes less relevant, despite the concern that there remain some children above 12 months who still are not consuming solid foods.

The 3 to 5 month olds are in a transitional phase with regards to the benefit of complementary foods. Table {SM IYCF2 D3a} shows there is no association between receiving solid, semi-solid or soft foods and HAZ at this age (model 8), although there is a slight interaction with age (model 7, $p=0.096$). Table {SM IYCF2 D3b} and fig. {SM

IYCF2 F.D1} illustrates that those not receiving complementary foods have lower HAZ by the time the child is 5 months. However this is probably a reflection of the counter-intuitive effect discussed previously, with exclusive breastfeeding.

Amongst 6 to 8 month olds, a significant bivariate association between HAZ and consumption of solid, semi-solid or soft foods is found that remains strong when controlling for age, gender, roofing, education and mother's height (table 2.61, model 7). In this group there appears to be a significant interaction with education (model 6), which is further explained table 2.62 and figure 2.60. The group with no education experiences a significant improvement in adjusted mean HAZ when transitioning from not consuming to consuming solid, semi-solid or soft foods, while the transition makes little difference among the educated group. 9 to 11 month olds exhibit the same associations and interaction with education as found in 6 to 8 month olds but on a smaller scale with the adjusted effect size going from 0.479 in 6 to 8 month olds (table 2.62, model 7) to 0.369 in 9 to 11 months olds (table 2.63, model 7). Table 2.64 and figure 2.61 depict the same interactive effect between consumption of solid, semi-solid or soft foods where the uneducated benefit more from the addition of complementary foods. By 12 to 14 months the association no longer exists as depicted in table {SM IYCF2 D6}.

This interaction – seen for example as the significant difference in slopes in Figures 2.60 and 2.61– is important, and good news for improving equity. The group with no education should benefit from interventions addressing correct timing of introduction of complementary foods; the children of the more educated are already at the better HAZ level. As given in the summary earlier, improving the timing of complementary foods for the 6-11 month olds could reduce stunting at population level by up to 10 ppts.

Consumption of solid, semi-solid and soft foods among sick children A possible alternative explanation for some of these results is that when children are sick there may be different IYCF practices – the variable derives from a question about the previous day – thus confounding the estimates. This was checked and found not to be a problem. The relevant tables are given in the supplementary material for the IYCF chapter, and described briefly here.

A variable was created from whether the child was reported as having either diarrhea, fever, or cough in the previous 2 weeks (this is how the question is posed). This showed (table {SM IYCF2A 1}) that 33.5 % were reported sick overall (all 3 surveys). In the 6-12 month group this was 52% (table {SM IYCF2A 2}). The cross-tabulation (table {SM IYCF2A 3}) shows there was no association of reported sickness with whether or not solid foods were consumed (chi-sq=0.88, p=0.36, n=2858). Thus the explanation for low percentages of timely introduction of solid foods was not related to sickness – it is not because sick children are reported to eat less solids.

However, table {SM IYCF2A 4} does show a potentially interesting effect – from all 3 surveys, only those not recently sick and consuming solid foods have an improved HAZ. This is apparent in table {SM IYCF2A 5}, for the 2011 survey only. This later would merit some further investigation.

Minimum meal frequency

The WHO definition of minimum meal frequency includes number of milk feeds for non-breastfeeding children; however the number of milk feeds was not recorded in the 2005 data so the definition was altered for this analysis (see table 2.1 B). As a result the number of feedings is calculated from only solid, semi-solid and soft foods for both breastfed and non-breastfed children. Additionally, since milk feeds are not counted for non-breastfed children, the minimum number of recommended meals was lowered from 4 to 3 meals for this group. The WHO definition of minimum meal frequency for breastfed children was not altered for this report, using the recommendation of 2 or more meals for 6 to 8 month old children and 3 or more meals for children 9 to 23 months olds (table 2.1 B). Using this slightly altered definition of minimum meal frequency there has been an increased number of children meeting this requirement, from 45.1% of 6 to 23 month olds in 2000 to 50.6% in 2011 (table 2.65). The largest increase in % of children meeting the minimum meal frequency recommendation occurred in the 6 to 8 month and the 9 to 11 month age groups which each experienced an increase of more than 16 percentage points from 2000 to 2011 (table 2.65). Nonetheless, the %s meeting minimum meal frequency are much lower than they should be.

Many regions also saw improvements in the number of children meeting the minimum meal frequency recommendation between 2000 and 2011, with significant increases in Tigray, Oromiya and SNNP. However, Affar, Amhara, Somali, Benishangul-Gumuz, Gambela and Harari experienced possible declines in this indicator over the same time period (table 2.65). Somali has by far the lowest prevalence of children meeting this recommendation at only 15.1% in 2011, followed by Affar at 26.1% (table 2.65). Again, this may be related to pastoralist livelihood.

Children who meet the minimum meal frequency as defined for this analysis have a higher mean HAZ than those who do not meet the recommendation across most age groups in all three surveys, with substantial and significant differences ($p < 0.01$) found in 6 to 8 and 9 to 11 month olds in 2011 (table 2.66). Figure 2.62 illustrates HAZ by age group and minimum meal frequency in 2011, where the beneficial effect diminishes after around 11 months as the two groups merge.

The bivariate associations between minimum meal frequency and HAZ found in 6 to 8 and 9 to 11 month olds remain when potential confounders are controlled for (table 2.67 A and table 2.68), with the effect size 0.35 to 0.33 HAZ. The 6 to 8 month analysis showed a significant interaction between minimum meal frequency and education on HAZ, similar to that found in the solid foods analysis (table 2.67 A, model 6). The interaction is explained by a positive change in HAZ of 0.5 in the uneducated group between those not receiving the minimum meal frequency and those who are, while there is almost no change among the educated group (table 2.67 B). This is further illustrated in figure 2.63. In 12 to 14 month olds the difference in HAZ between the minimum meal frequency groups remains insignificant at 0.2 when controlling for covariates (table {SM

IYCF2 E5}, model 7), demonstrating the waning effect of this variable with age as found in the bivariate results (table 2.66).

This again is important in that an intervention addressed at the meal frequency is likely to benefit the uneducated group more than the educated, thus being equity positive.

Minimum dietary diversity

Minimum dietary diversity is defined by WHO as the percentage of children 6 to 23 months old receiving at least 4 out of 7 possible foods groups (WHO, 2008). This definition has been adjusted to match the availability of data across all three surveys. In the 2000 data there is not a separate variable for eggs, rather they are included with other meats and animal foods, so the definition has been altered to allow a total of 6 food groups (see table 2.1 B). Percentages of children receiving the recommended minimum dietary diversity are given separately for breastfed and non-breastfed children since breastmilk is not counted as a food group, resulting in generally lower prevalences of this indicator among breastfed children. Additionally, very few children in Ethiopia receive foods from 4 different food groups. Table 2.69 illustrates this with only 3.9% of breastfed children and 10.8% of non-breastfed children meeting the minimum of 4 food groups in 2011, a decline from 6.8% and 18.9% respectively in 2000. Since the total number of food groups was reduced and so few children meet the 4 foods recommendation, this indicator was also assessed using a definition of 3 or more foods out of 6 possible foods groups.

Nationally, by this definition, minimum dietary diversity adequacy is low and declined from 2000 to 2011 in both breastfed (21.0% to 16.9%) and non-breastfed (49.8% to 30.0%) 6-23 month children (table 2.70).

All regions also experienced a decrease in the prevalence of 6 to 23 month olds receiving foods from 3 food groups between 2000 and 2011 except for Tigray, which increased from 8.4% to 17.2% during the period (table 2.70). The region with the lowest prevalence of children meeting this recommendation is Somali at only 5.3% in 2011, followed by Affar (10.5%) and Amhara (12.1%). Meeting the dietary diversity recommendation remains a challenge in all regions, with the highest percentage being only 22.2% in Gambela and Dire Dawa in 2011 using the modified definition of only 3 food groups.

Children who receive foods from 3 or more food groups have a higher mean HAZ than children who consume a less diverse diet across almost all age groups and all survey years (table 2.71). However the effect size seems to increase in some of the older age groups. With further analysis of the 2011 data, no significant association was found in 6 to 8 month olds between HAZ and minimum dietary diversity (table {SM IYCF2 F3}). In 9 to 11 month olds a mild interactive effect between minimum dietary diversity and education was found in the regression analysis (table {SM IYCF2 F4a}, model 5). This interaction exhibited the same effect as found in the other food related indicators where a

large improvement is found among the uneducated with little improvement seen in the educated group (table {SM IYCF2 F4b}). However, this interaction does not remain significant when mother's height is added to the model (table {SM IYCF2 F4a}, model 6) and it includes a small sample size of 19 in the uneducated, receiving the minimum dietary diversity category (table {SM IYCF2 F4b}). In the 12 to 14 month group the association begins to emerge between dietary diversity and HAZ but is still small with an effect size of 0.27 ($p=0.199$, table {SM IYCF2 F5}, model 7). The impact of dietary diversity on HAZ grows in the next two age groups with an adjusted effect size of 0.30 in 15 to 17 month olds (table 2.72, model 7) and 0.32 in 18 to 20 month olds (table 2.73, model 7). By 21 to 23 months the dietary diversity indicator no longer is associated with HAZ (table 2.74).

Minimum acceptable diet

Minimum acceptable diet is a summation variable of the two previous indicators: minimum dietary diversity and minimum meal frequency. As a result, the WHO definition of this indicator was altered slightly to be usable with all three data sets. Those who meet this recommendation are those who meet the minimum dietary diversity as defined by the changes made for this analysis, and who meet the minimum meal frequency definition used here (see table 2.1 B, for details). The percentage of 6 to 23 month old children meeting the minimum acceptable diet as defined decreased from 2000 to 2011 going from 16.4% to 14.8% (table 2.75). This smaller decline has been driven by a larger decrease in dietary diversity since improvements were seen in meal frequency. Within 6-month age groups, the 12 to 17 month old children experienced the largest decline in this indicator, going from 19.7% in 2000 to 14.2% in 2011 (table 2.75).

Tigray and SNNP actually saw improvements in the percentages of children meeting the minimum acceptable diet recommendation from 2000 to 2011, while Dire Dawa maintained a steady prevalence (table G.1.). The other regions all experienced declines similar to the national trend. The regions with the fewest children consuming a minimum acceptable diet in 2011 are Affar (4.3%), Somali (5.4%), and Amhara (8.4%); all other regions had prevalences of 14 to 20% in 2011 (table 2.75).

Children achieving a minimum acceptable diet exhibited a higher mean HAZ than those not, across all six month age groups and surveys (table 2.76). However this difference is only significant in 6 to 11 month olds in 2011 ($p \leq 0.05$).

Consumption of iron-rich or iron-fortified foods

Consumption of iron rich foods was determined by the variables asking if the child ate meat, fish, poultry, organ meats, or eggs. Using this definition, the percentage of children ages 6 to 23 months that consume iron-rich foods increased slightly from 2000 to 2011 going from 11.5% to 13.1% (table 2.77). The largest improvement was found in the

youngest age group of 6 to 11 month olds, going from 7 to 10.7% of children consuming iron rich foods.

Affar, Somali, SNNP, Gambela, Harari and Addis Ababa all defied the national trend, exhibiting decreases in consumption of iron rich foods from 2000 to 2011 (table 2.77). The other regions all saw small increases during this time frame. Affar, Somali, and SNNP are the regions with the lowest percentage of children consuming iron-rich foods, all with prevalences below 10% in 2011 (table 2.77).

Access to Health Services

Introduction

Access to health services is analyzed here for correlations with child HAZ. The DHS data does not have specific information on health services access; therefore, several variables are used as proxies. This topic was explored in two general areas revolving around child age: (1) health services access concerning birth is assessed in children less than two years; (2) health services access for older children, e.g. measles immunization, is assessed in children two years and older. The proxies used to assess access to health services around birth include: place of delivery, antenatal care personnel (doctor, nurse, midwife, no one, etc.), and number antenatal care visits. The proxy variables used to look at health services access for older children include: possession of a health card, measles immunization, and treatment of diarrhea.

Summary of Results

Access to Health Services around the time of birth: ages < 24 months

Place of delivery Many births occur outside of health facilities with the large majority of deliveries taking place in the home. Although home deliveries have decreased from 2000 to 2011 across most regions, livelihoods, and urban and rural locations, there remain a significantly high percentage of births taking place outside of health care facilities, illustrating a lack of access the health care services for mothers and children at birth.

Additionally, home delivery is associated with lower HAZ scores among children born in the previous two years. There is also an interaction between home delivery and lack of proper sanitation facilities, modifying the effect of home delivery on HAZ. The interaction is such that there is minimal difference in HAZ between those delivering at home versus in a health facility among those with no toilet access. Meanwhile, there is a much greater difference in HAZ among those with toilet facilities, between home deliveries and health facility deliveries.

Antenatal care There have been improvements in access to antenatal care from 2000 to 2011, but still over 50% of mother's did not receive any form of care during her pregnancy within the 2 years preceding the 2011 survey. Access is worse in rural areas, and for pastoralists, further exemplified by Affar and Somali being the regions with the lowest rates of mother's receiving antenatal care.

Antenatal care is positively associated with HAZ, but its effect is modified by education level. The interaction is such that only those with some education experience the

improved growth outcomes associated with receiving antenatal care during the pregnancy. This demonstrates another unfortunate equity-negative interaction.

Access to health services for children later on: ages ≥ 24 months

Health card The numbers of children with health cards has increased from 2000 to 2011 nationally, but 44% of children greater than 2 years still did not have health cards in 2011. Affar and Somali have much lower percentages of children with health cards, along with pastoralists in general, compared to the other livelihood groups. Rural areas are worse off on this measure compared to urban areas, though the improvements have been greater since 2000 in rural areas, indicating a possibly shrinking of the gap in access to health services between urban and rural areas. There is no clear association between having a health card and improved growth.

Measles immunization Measles immunizations have increased nationally from 33% to 58% during the 11-year period between survey 1 and 3. All regions also had improved measles vaccination rates except for Somali. Somali and Affar again have the lowest rates, but Affar has experienced a large improvement from 2000 to 2011 (unlike Somali). As seen with the other indicators of health services access, pastoralists have the lowest measles vaccination coverage among the livelihood groups, and rural areas are worse off than urban areas, although pastoralists and rural areas have experienced greater improvements so this is good news for equity. There is no apparent correlative association between measles immunization and HAZ in children 2 years and older.

Treatment of sick children The treatment of children who recently had diarrhea was assessed in children 2 years of age and older in order to assess a more clear definition of health services use. Within the more limited sample of those children who had diarrhea in the past 2 weeks, about 10% of the 2011 sample, only 35% received medical treatment, with an additional 3.5% receiving some sort of other, non-medical facility based treatment. Again there is no clear association between those receiving treatment and HAZ.

Results

Access to Health Services around the time of birth: ages < 24 months

Note on sample used Place of delivery, antenatal care personnel, and number of antenatal care visits were evaluated in children less than 2 years of age only, for both descriptive and correlational analysis. Purely descriptive analyses include all children, regardless of how the height/ length was measured. Any analyses of HAZ includes only children correctly measured lying (since all are < 24 months).

Place of delivery

Place of delivery – descriptive statistics The large majority of children in Ethiopia are delivered in a home, though the percentage has decreased slightly from 94.9% in 2000 to 88.2% in 2011 (significant at $p < 0.001$, table 2.78). The remaining births are mostly occurring in public facilities, which have seen the majority of the corresponding increase in deliveries during the 11-year span, from 4.7% to 10% of all births occurring in public facilities (table 2.78).

Similar results are found at the regional level, with all regions but Somali experiencing a decline in the percentage of home deliveries between 2000 and 2011 (table 2.79). Tigray, Amhara, and Oromiya had the most significant decreases in home births, all with p -values < 0.001 (Pearson's Chi-Square test between 2000 and 2011). Addis Ababa, being primarily urban, is an exception with only 15.4% of births being delivered in the home in 2011. Dire Dawa, Harari and Gambela are also different than the remaining regions with the percentage of home births ranging from 57% to 71% in 2011. All other regions had more than 80% of deliveries in the home in 2011, among children born in the preceding 2 years.

Among different livelihood groups, the agro-pastoralists had the most home deliveries in 2011 at 94.3%, but this is not much higher than the pastoralists (92.5%) or the agriculturalists (89.7%) (table 2.80). Urban populations have far fewer home births compared to rural at 42% to 95% respectively. This was illustrated by the lower percentages of home deliveries in the more urban regions of Addis Ababa and Dire Dawa.

Although there have been consistent reductions in home births across regions, within livelihoods, and by urban and rural locations over the 11-year period, the still high percentage of deliveries occurring outside of health facilities indicates a gap in access to health services for mothers and children around the time of birth, especially among rural populations.

Place of delivery – correlational analysis Children born in the home have a significantly lower mean HAZ compared to children born in health facility settings (table {SM HS IA4}). This difference is found in all survey years: 2000, 2005 and 2011 ($p = 0.000$ in 2000 and 2011). Within livelihood groups, only agriculturalists have enough facility births for comparison – again demonstrating the rarity of facility births in rural areas – where the same trend is found in 2000 and 2011; children born in facility settings having a significantly higher mean HAZ (table {SM HS IA4}). Within urban areas, which exhibit the highest percentage of facility births, the effect size between facility and home births is quite high at 0.94 and 0.50 HAZ in 2000 and 2011 (table {SM HS IA4}). In the rural population, these differences were 0.36 ($p = 0.110$) and 0.60 ($p = 0.000$) in 2000 and 2011 respectively, indicating a potentially important association for the majority of the population.

Improvements in HAZ and stunting prevalence between 2000 and 2011 persisted within those delivering at home, further illustrating the positive conclusions from the trends

section: everyone is improving. The pastoralist, for example, experienced a huge reduction in stunting of 25 percentage points among home deliverers during the time (table {SM HS IA4}).

Regional bivariate associations of HAZ by delivery location are given in table {SM HS IA5}. In 2000 and 2005 facility deliveries were so few that most regions had too small of a sample to compare with home deliveries, except for the more urban Addis Ababa and Dire Dawa. In 2011 there were more facility deliveries in most regions, with higher HAZ among facility deliveries persisting. Tigray, Amhara and Oromiya were the only regions with significant bivariate differences in HAZ by delivery place (though these are based on the weighted means) (table {SM HS IA5}).

Further assessment of the association of home delivery and low height for age in the 2011 data illustrates a robust correlation that remains when potential confounders are controlled for, including age, gender, education, roofing quality, water source, toilet and mother's height. Interactions between home delivery and the covariates were tested, and dropped if the interaction p-values were greater than 0.1. Table 2.81 illustrates the models tested and the persistent effect of home delivery on HAZ, with a coefficient of -0.374 when controlling for these other factors (model 9). In addition, an interaction appeared between home delivery and no toilet on HAZ, which remained significant with all of the other variables in the model (model 8). This interaction was further explored by calculating adjusted means of HAZ by delivery location and no toilet category (table 2.82, means are adjusted for all variables mentioned). The table clarifies the direction of the interaction, showing a greater difference in HAZ based on delivery location among those with sanitation facilities, and very little difference for those with no toilet.²³ This relation is easily depicted in figure 2.64, which shows the interaction in HAZ terms. Note that the outlying group, those with education and having had health facility deliveries, who appear much improved in terms of height for age, include a relatively small percent of the total sample (n=389 out of total n=3398), so this is not affecting a large part of the population. (Figure 2.65 represents the stunting prevalence within the interaction categories, which shows a less pronounced interaction – 2.6 percentage points difference within the no toilet group compared to 4.9 percentage points within the any toilet group. Table {SM HS IA5b} and figures {SM HS F.IA5b1-2} give the same interaction but the results are weighted. The weighting is not used in the regression analyses but was tested with this interaction. The effect of weighting resulted in less significance of the interaction, but still moderately present.

Antenatal care – assistance personnel

Antenatal care – assistance personnel – descriptive statistics The percentage of children whose mothers received antenatal care during pregnancy from any form of health professional has increased substantially from only 25.7% in 2000 to 43.3% in 2011 (table 2.83). However, the remaining 56.7% are still not receiving appropriate care

²³ This is an equity-negative interaction; only the already better off, those with some education, see improvements in child growth with better access to health care, in this case, facility deliveries.

during pregnancy. The type of healthcare professional delivering the antenatal care in 2011 is given in table 2.84. The majority of care is given by nurses or midwives at 29%, followed by 10.7% receiving care from health extension workers, with only 3.5% receiving care from a doctor. The care received by mothers of children older than 24 months is also given to assess change within the preceding 5 years. The types of antenatal care personnel used have been relatively unchanged, with a slight increase in health extension workers corresponding with a small decrease in nurses and midwives.

Most regions also experienced a large increase in the percentage of mothers receiving prenatal care from a health professional during the 11-year period (table 2.85). The changes were most significant in Tigray, Amhara, Oromiya, SNNP, and Addis Ababa. Addis Ababa has by far the most antenatal care with 96.7% of mothers reporting to have received some form of prenatal care for pregnancies in the previous 2 years in 2011. Tigray, Gambela, Harari, and Dire Dawa are also doing comparatively well with 50% or more mothers reportedly receiving some antenatal care. Somali and Affar have the least antenatal care at only 28% and 33% in 2011 respectively.

The increase in antenatal care from 2000 to 2011 was seen within all livelihood groups, and within both urban and rural locales as well, though the agriculturalists experienced a larger improvement than the agro-pastoralists and pastoralists – 18 percentage points change for agriculturalists compared to 13 percentage points and 19 percentage points (table 2.86). The pastoralists still have less access to care than other livelihoods at only 30.2% in 2011. Urban regions have much greater access to care at 79.4% compared to 37.8% in rural regions.

Antenatal care – assistance personnel – correlational analysis In both 2000 and 2011, children whose mothers had received antenatal care from any health care professional had higher HAZ scores, and lower rates of stunting, compared to those who received no care (table {SM HS IB4}). The weighted, bivariate difference in HAZ was significant at p-values<0.01 in both years. The same is seen within livelihood groups, and urban and rural locales, except for pastoralists where the direction is reversed – higher HAZ among those with no care.²⁴ The difference in HAZ by care received was most significant among agro-pastoralists in 2011.

The relationship between HAZ and receiving antenatal care from any health professional was further tested with regression analysis depicted in table 2.87. The bivariate (un-weighted) association is seen in model 1, which gets stronger when age and gender are controlled for – the coefficient increases from 0.128 to 0.230 (model 1 to model 3). When education, roofing quality, water source, toilet, and mother's height are all included, with their interactions tested, an interaction between education and prenatal care appears significant (model 8). Mother's height is always added to the relevant

²⁴ This reversed direction found among pastoralists cannot be further explored here beyond the regression analyses, but could be explained by poor access to health services for pastoralists in general. Those in the received care category may in fact have had minimal care, given that pastoralists have the least access to care of all the livelihood groups, receiving much less care than would be truly protective.

models last, in order to see if the effect remains while controlling for possible biological growth patterns. Given that the addition of this variable often significantly alters the coefficient of the variable of interest (in this case: antenatal care), it was decided to test the same models while removing some of the regions with the tallest people. Somali and Gambela have consistently had the tallest respondents in each survey year with average heights of respondents always above 161 centimeters (table {SM HS A.IIC2}). The next tallest region had an average height of respondents of only 158 centimeters in 2011. When these two regions were removed, the results remained consistent with a significant interaction surfacing between education and antenatal care on HAZ (table 2.89).

This interaction was tested by calculating the adjusted mean HAZ by category of education and antenatal care received (table 2.90); means are adjusted for everything controlled for in the regression analysis presented in table 2.89. Within this breakdown, the interaction presents its direction, showing a much greater difference in HAZ by antenatal care received among those with any education (difference in HAZ=0.262, $p=0.01$); there is very little difference among the uneducated (difference in HAZ=-0.022, $p=0.75$). This is illustrated in figure 2.66. The interaction also presents itself in stunting outcomes (figure 2.67), where those receiving care with education have a much lower prevalence of stunting than those without education. The adjusted *weighted* means and corresponding figures show the same interaction, but to slightly less significance, and are given in the supplementary material (table {SM HS IB6b} and figures {SM HS F.IB6b1-2}). This is not good news, suggesting that improving access to health care, such as antenatal care, does not, on its own, improve growth for the uneducated.²⁵

Antenatal care – number of visits

Antenatal care – number of visits – descriptive statistics Antenatal care was also assessed with the variable that asked mothers the number of antenatal care visits they had during their pregnancy, for children less than 2 years. The results are similar to those found looking at type of health care personnel that provided any antenatal care. The average number of visits has increased from 0.87 in 2000 to 1.51 in 2011 (table 2.91). Similarly, the number of mothers with 0 antenatal care visits has decreased significantly from 74% on 2000 to 57% in 2011.

The same improvements in antenatal care visits were also seen regionally, with the most significant changes from 2000 to 2011 being found again in Tigray, Amhara, Oromiya, SNNP, and Addis Ababa (table 2.92). Somali and Affar still have the least access to care, with only 28% and 33% of mothers reporting having gone to at least 1 antenatal care visit. Again, the agriculturalists and agro-pastoralists have greater access to care than the pastoralists, while mothers in urban areas have more access than those in rural areas (table 2.93).

²⁵ This is an equity-negative interaction: improving access to health services on its own will only help the already better off, increasing the gap between the educated and uneducated.

The low percentage of mothers having had even 1 antenatal care visit is not a positive reflection on the access to health services throughout the country, as the recommended number of visits is at least 4. There is much improvement to be made in access to health care around the time of birth, with only urban areas doing seemingly well on this front.

Antenatal care – number of visits – correlational analysis The relationship between antenatal care, measured by number of antenatal care visits of 0 versus 1 or more, and HAZ was evaluated to reaffirm the conclusions found with antenatal care personnel. Having had 1 or more antenatal visits is associated with higher HAZ scores for children less than 2 years in both the 2000 and 2011 data (differences in HAZ are significant at p-values ≤ 0.001) (table {SM HS ID4}). The same applies within livelihood groups, and urban and rural locales in 2011, except for among pastoralists, where those with 1 or more antenatal visit actually have a lower mean HAZ.²⁶

The regression models reveal the same interaction found in the previous antenatal care section: education modifies the effect of antenatal care visits on HAZ (table 2.94, model 8). No other interactions tested were significant. Again the interaction is revealed in the adjusted means table giving HAZ by category of education and antenatal visits (table 2.95). The uneducated experience no difference in HAZ by receiving more antenatal care, as depicted by the flat line in figure 2.68, compared to those with any education who experience a much-improved outcome with access to antenatal care.²⁷ The prevalence of stunting in the four categories reveals the same interaction (figure 2.69). When the adjusted means are weighted, the direction of the interaction remains unchanged but the strength is slightly less (table {SM HS ID6b} and figures {SM HS F.ID6b1-2}).

Access to health services for children later on: ages ≥ 24 months

Note on sample used Health card possession, measles immunization, and treatment of recently sick children were evaluated in children 2 years of age and older, for both descriptive and correlational analysis. Purely descriptive analyses include all children, regardless of how the height/ length was measured. Any analyses of HAZ includes only children correctly measured standing (since all are ≥ 24 months).

Health card

²⁶ See footnote 1, where the same reversed direction was found among pastoralists in the previous section on antenatal care personnel. Those in the good group, i.e. 1 or more antenatal visits, may in fact had only gone to 1 visit, which is far less than would be expected to provide benefit for the health of the pregnancy.

²⁷ This is another equity negative interaction, such that only the already better off improve with greater access to care.

Health card – descriptive statistics The percentage of children with health cards has increased from 2000 to 2011, going from 43% to nearly 56% in 2011 (table 2.96). This is good news indicating a growth in a measure of potential for access to health services, but there were still 44% without health cards in 2011.

The percentage of children with health cards varies drastically across regions and has changed from 2000 to 2011. Most regions exhibit increases in the percentage of children with health cards during the time period, with significant changes in Tigray, Amhara, Oromiya, SNNP, and Addis Ababa (table 2.97). The exceptions were Somali and Dire Dawa which both reported lower percentages with health cards in 2011 than 2000. In 2011 Addis Ababa had the highest percentage of children with health cards at 97% with Tigray close behind at 90.9%. Affar and Somali had the lowest percent of children with health cards in 2011 at 26.5% and 29.3% respectively, further illustrating the lack of access to health services in these more remote Eastern regions as demonstrated with the previously used variables for children less than 2.

Among the livelihood groups, the pastoralists have the least access to health care measured by percentage of children with health cards, 40.9% in 2011 compared to greater than 50% among agro-pastoralists and agriculturalists (table 2.98). Though, in 2000 only 7.7% of pastoralist children and 19.1% of agro-pastoralist children had health cards, so there have been major improvements. Similarly, though urban areas have a higher percentage of children with health cards, there have been greater increases in the rural areas, going from 39% in 2000 to 54% in 2011, indicating perhaps well targeted expansion of access to health care through the delivery of health cards.

Health card – correlational analysis HAZ does not appear to be consistently associated with the ownership of a health card, as the direction of the difference in HAZ varies from year to year and across different groups. In 2000, those with a health card had a slightly higher mean HAZ (table {SM HS IIA5}), illustrating the expected direction if having a health card improves access to health services. However, in 2011 the direction is the opposite, though the difference is not significant. Agriculturalists and pastoralists also exhibit this reversed direction, as do children in rural areas. This inconsistency suggests there is no real correlation between having a health card and improved growth. This conclusion is confirmed via regression analysis (table {SM HS IIA6}).

Although there appears no real association between child growth and having a health card, it is still likely an important indicator of ability to access the health system. There is little way of knowing if children with health cards ever actually use health services from our data, so additional variables are explored to attempt to look at actual health services use.

Measles immunization

Measles immunization – descriptive statistics Measles vaccinations have also increased nationally from 2000 to 2011 going from 33% to 58% (table 2.99). However, this also means 42% of children 2 years of age and older were still unvaccinated for measles in 2011.

All regions, except for Somali, have also had increases in measles immunizations from 2000 to 2011 (table 2.100). Affar and Somali once again are the worst off of the regions, with the lowest rates of immunization for measles at 27.5% and 27% in 2011, although this was a 20 percentage points increase for Affar. Tigray, Addis Ababa, and Dire Dawa are all doing exceptionally well with greater than 80% measles immunization in 2011, while Amhara, Benishangul-Gumuz, and Harari are all above 60%.

Once again, pastoralists are the worst off of the livelihood groups with 42.6% measles immunization, but they have had by far the biggest increase from 2000 when only 6% were immunized (table 2.101). Similar results are found in rural areas, where they still have lower immunization rates than urban areas, but have experienced a larger increase since 2011. Though there remain improvements to be made, these results are positive in that they illustrate a shrinking gap in health services access between rural and urban areas, and by livelihood groups.

Measles immunization – correlational analysis Similar to the health card analysis, children with the measles immunization are generally not better off in terms of HAZ in 2011, though the prevalence of stunting is slightly lower in this group compared to those without vaccination (table {SM HS IIB4}). The inconsistent direction of association of HAZ by measles vaccination, along with the difference in direction from stunting prevalence, indicates a lack of correlation between measles immunization and child growth. This is confirmed in regression analysis where there appears very little effect, to no significance, of measles immunization on HAZ (table {SM HS IIB5}).

Treatment of sick children

In attempt to look at a more specific use of health services, treatment sought for children who were recently sick with diarrhea was investigated. This still uses children 2 years of age and older with the further limitation of including in the sample only children who had diarrhea in the previous two weeks. Out of all children ages 24 months and older in the 2011 data, only 9.7% were reportedly sick with diarrhea in the previous two weeks (table 2.102). This is a 9 percentage points decrease from the number of children with diarrhea in 2000.

Treatment of sick children – descriptive statistics Among children who recently had diarrhea, many sought no treatment. In 2000, as many as 80% did not receive any treatment and in 2011 this figure was down to 61.6% (table 2.103). For those who did receive treatment in 2011, the majority went to government facilities or community based outlets (27.4% of all recently sick children), which is much increased from 9% in 2000. 7.5% of sick children sought care at a private or NGO health facility and 3.5% sought

non-medical facility based treatment (i.e. shop, drug vendor, traditional practitioner, etc.). In sum, the percentage of children who recently had diarrhea that received some sort of medical treatment increased from 11.6% in 2000 to 34.9% in 2011, while those seeking non-medical facility based treatment has decreased from 8% to 3.5% during the same time period (table 2.104).

Regionally, the highest percentages of children with diarrhea who receive no treatment are in Tigray, Amhara, Somali, and SNNP which all reported more than 60% going without treatment in 2011 (table 2.015). On a positive note, most regions have seen the number going without treatment decline over the 11-year period, with the exception being Somali.

The pastoralists have the highest percentage of sick children going without treatment at 75% in 2011, compared to around 60% among agro-pastoralists and agriculturalists (table 2.016). In addition, agriculturalists and agro-pastoralists experienced a greater decline of about 20 percentage points in the percent receiving no treatment, compared to 15 percentage points among pastoralists. Rural areas, on the other hand experienced a much larger decline in sick children receiving no treatment compared to urban areas from 2000 to 2011.

Treatment of sick children – correlational analysis The bivariate association between HAZ and treatment for diarrhea among children who recently had diarrhea appears in the expected direction in 2011, and the difference is significant (HAZ among no treatment category is -0.32 lower than those who received treatment, $p=0.039$) (table {SM HS IIC4}). The same trend is seen within agriculturalists and in rural areas, though the difference is not significant in the rural sample. The agro-pastoralists and pastoralists do not have a large enough sample of children receiving treatment for comparison; the urban areas do not have a large enough sample of children not receiving treatment for comparison.

When the association between receiving treatment for diarrhea and HAZ is further tested through regression, the un-weighted results indicate no association in the bivariate with a coefficient of 0.074 (compared to the weighted coefficient of -0.32) (table {SM HS IIC5}). Age and gender are added to the model to ensure no confounding effect. The age and treatment sought interaction is also assessed. Receiving treatment for diarrhea remains to be unassociated with HAZ through the un-weighted regression analysis.

Out of curiosity, treatment of diarrhea was tested with the same regression models using weight-for-height z-score (WHZ) as the outcome, thinking recent diarrhea likely has a greater impact on this measure of growth. The results remained insignificant (table {SM HS IIC6}), further indicating no association between having treated the child's diarrhea and growth outcomes.

References

1. Chotard S, Mason JB, Oliphant NP, et al. Fluctuations in wasting in vulnerable child populations in the Greater Horn of Africa. Food and nutrition bulletin 2010;**31**(3 Suppl):S219-33.
2. White J, Mason JB. Assessing the impact on child nutrition of the Ethiopia Community-based Nutrition Program. (Report to UNICEF of an evaluation study). New Orleans, LA USA: Tulane University SPHTM, 2012.
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4. Marquis GS, Habicht JP, Lanata CF, et al. Association of breastfeeding and stunting in Peruvian toddlers: an example of reverse causality. International journal of epidemiology 1997;**26**(2):349-56.

2. Nutrition Situation Analysis for Guiding Decisions on Interventions

FIGURES

2.A Methods – Figures

Figure 2.1 Number of children by age (18-30 months) measured lying or standing (2011 survey).

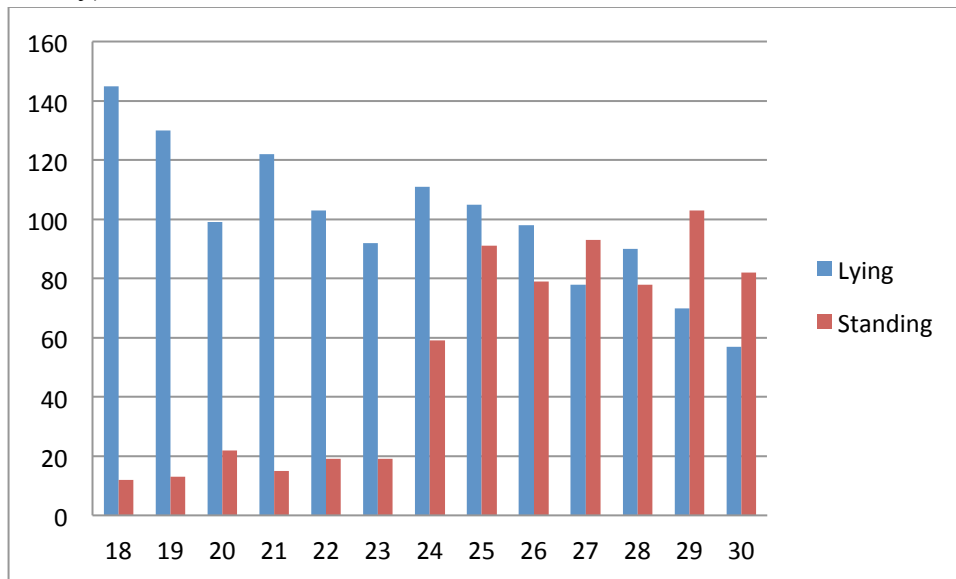


Figure 2.2 Heights by age measured lying or standing (2011 survey).

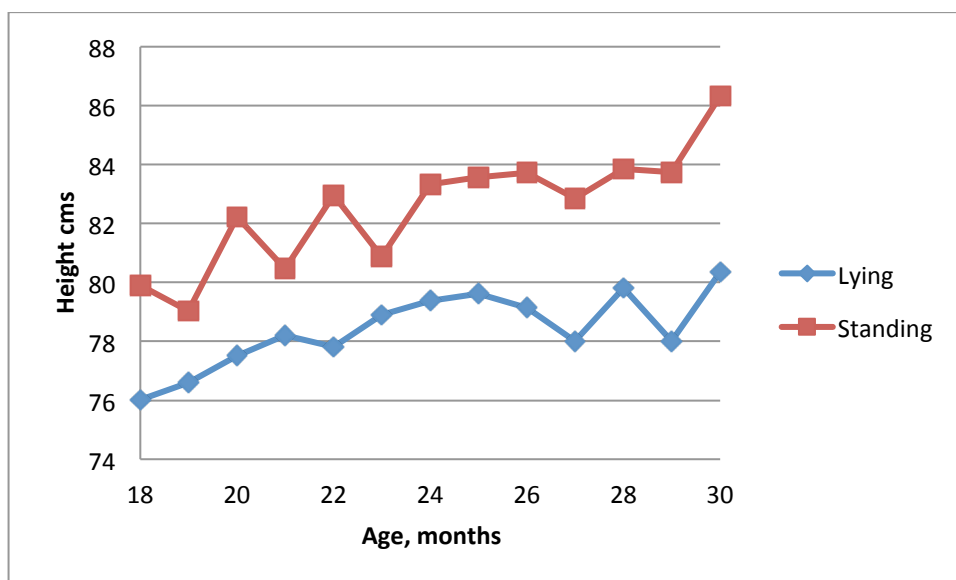
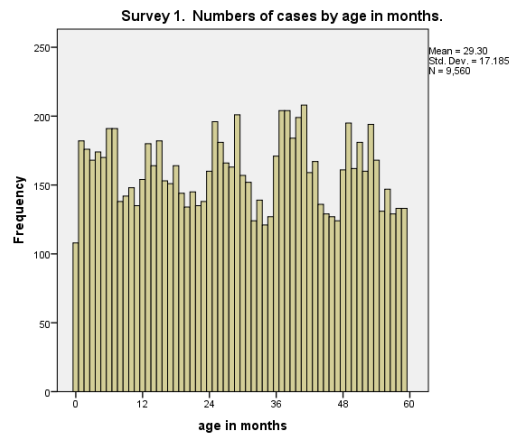
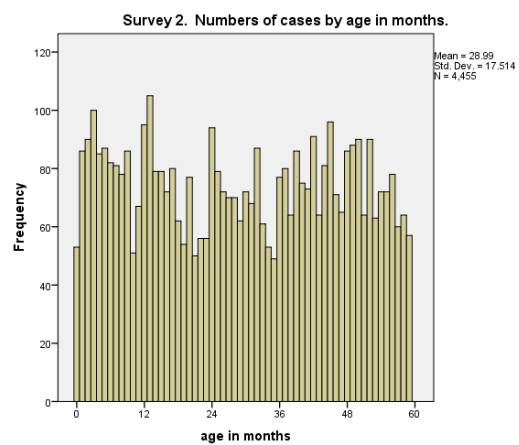


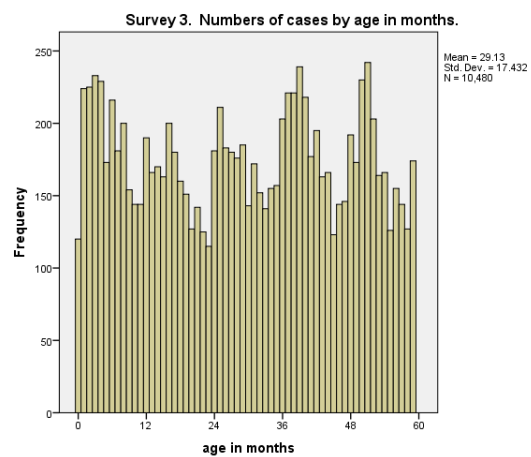
Figure 2.3 Age heaping by number of cases and age in months by survey.



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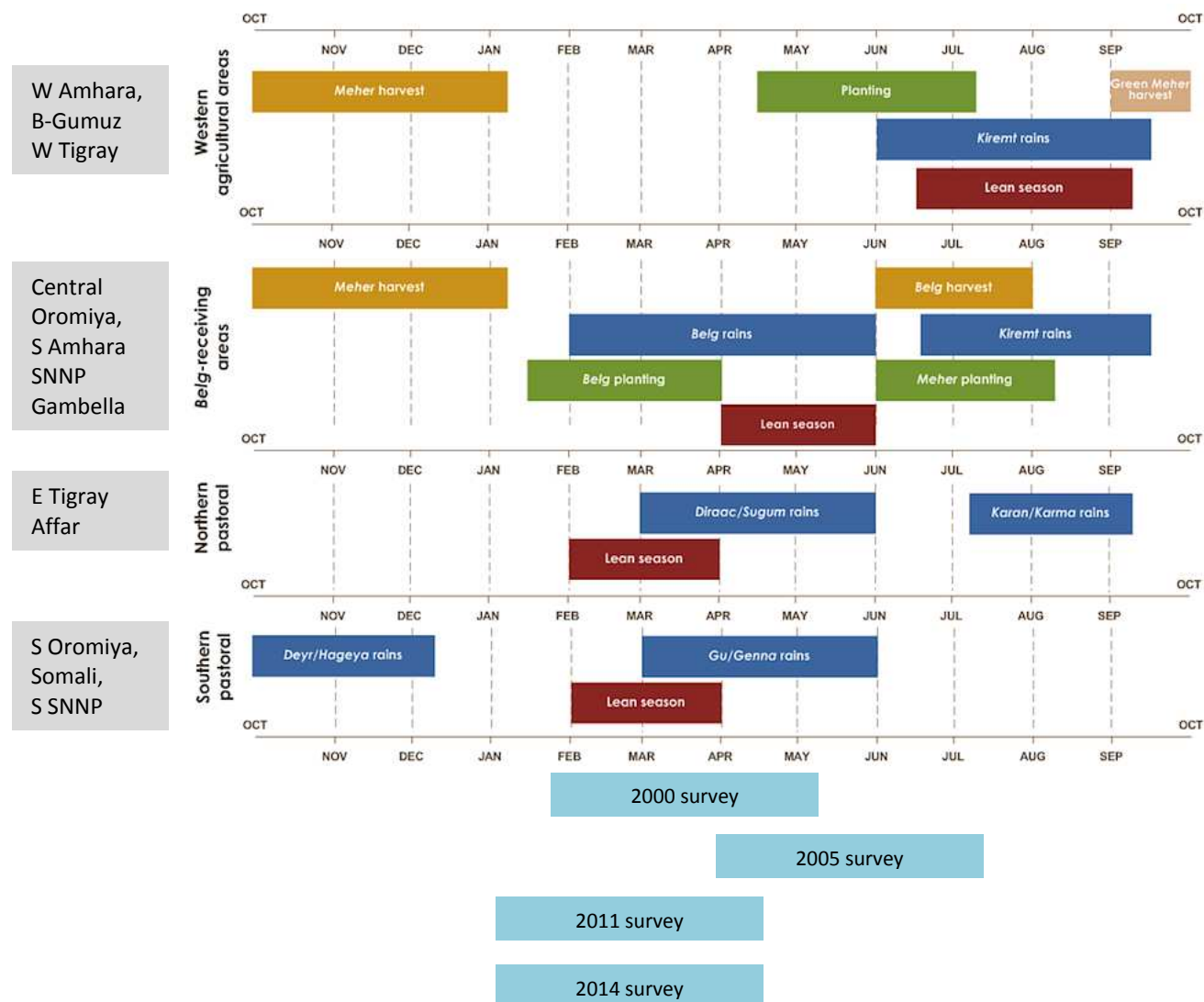


MAR = 0.146



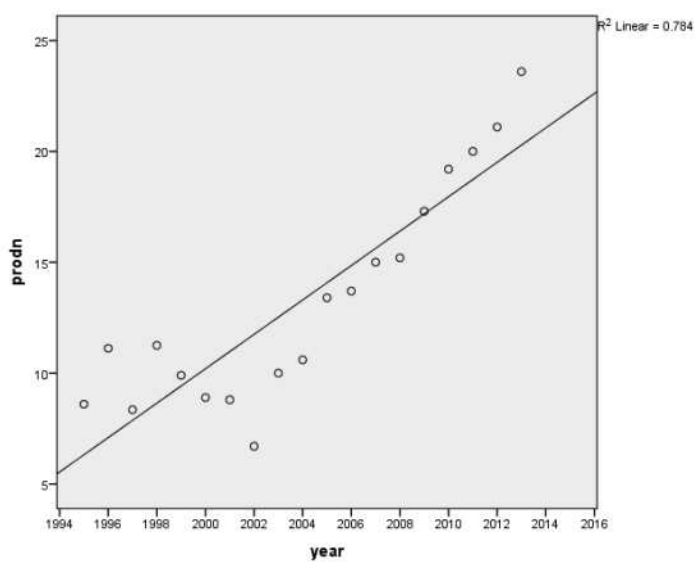
MAR = 0.151

Figure 2.4 Crop calendar.

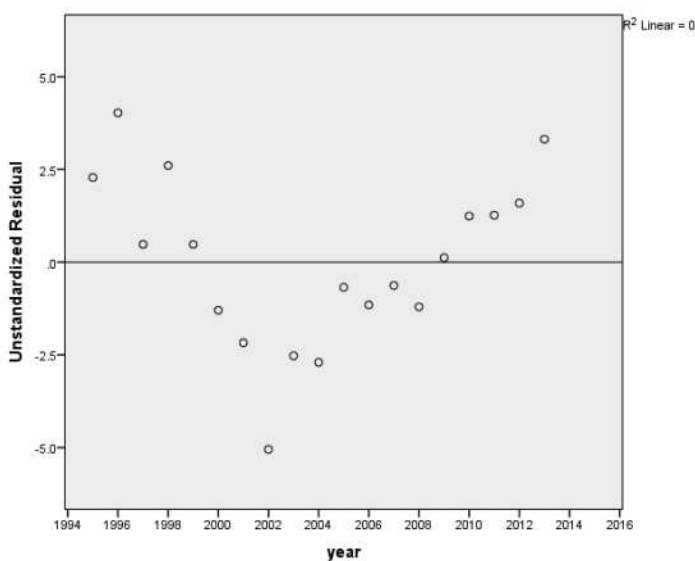


Source: <http://www.fews.net/east-africa/ethiopia>

Figure 2.5 Crop production data.



Residuals



Source: FAO

Figure 2.6 Administrative regions and zones of Ethiopia.

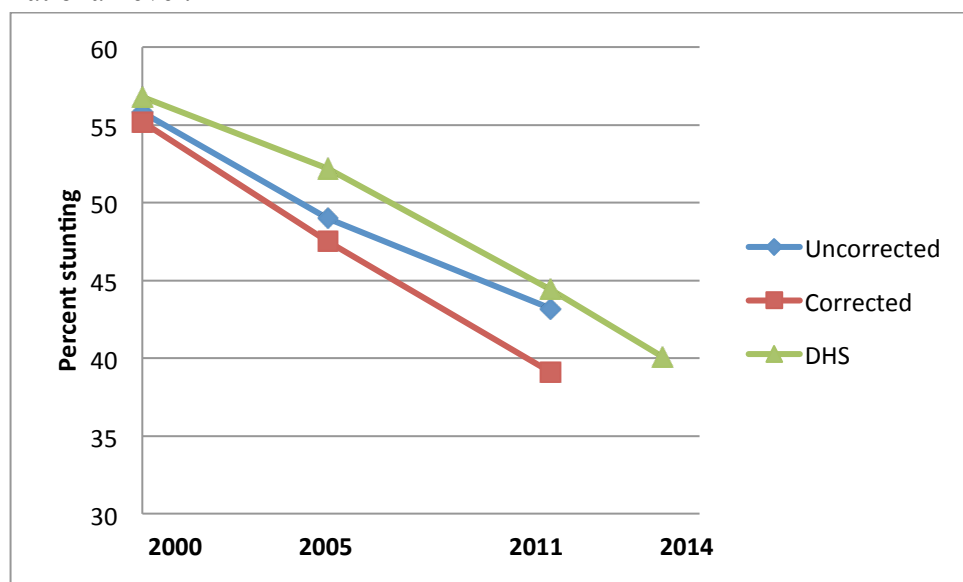
Administrative Regions and Zones of Ethiopia



<http://faostat3.fao.org/browse/area/238/E>

2.B Trends and Differentials in Children's Nutritional Status - Figures

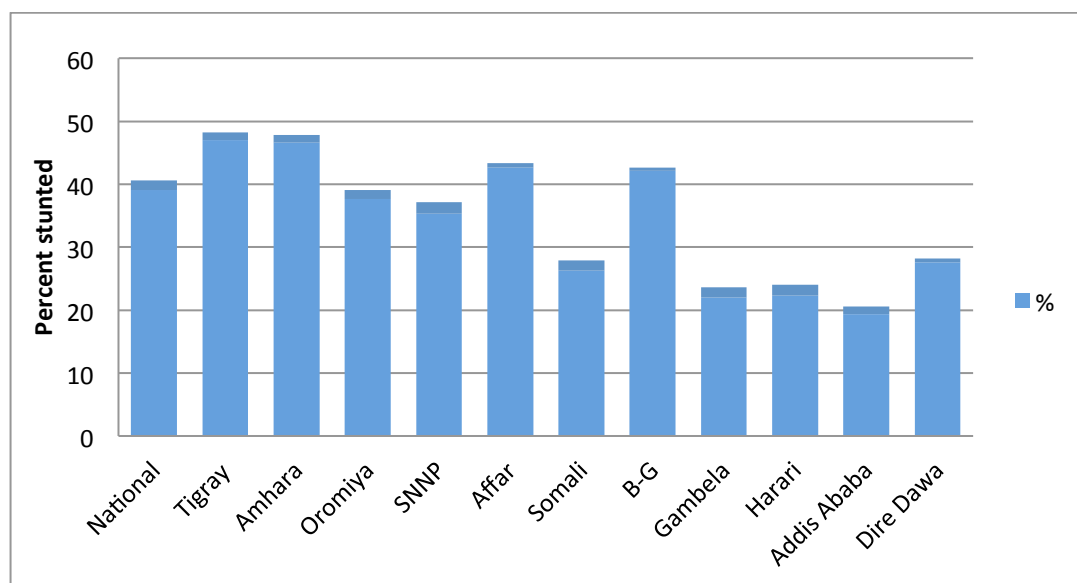
Figure 2.7 Trends in stunting prevalences (<-2SDs HAZ) in children 0-5 years, 2000-05-11, national level.



Source: calculated from cleaned DHS data (2000, 2005, and 2011).

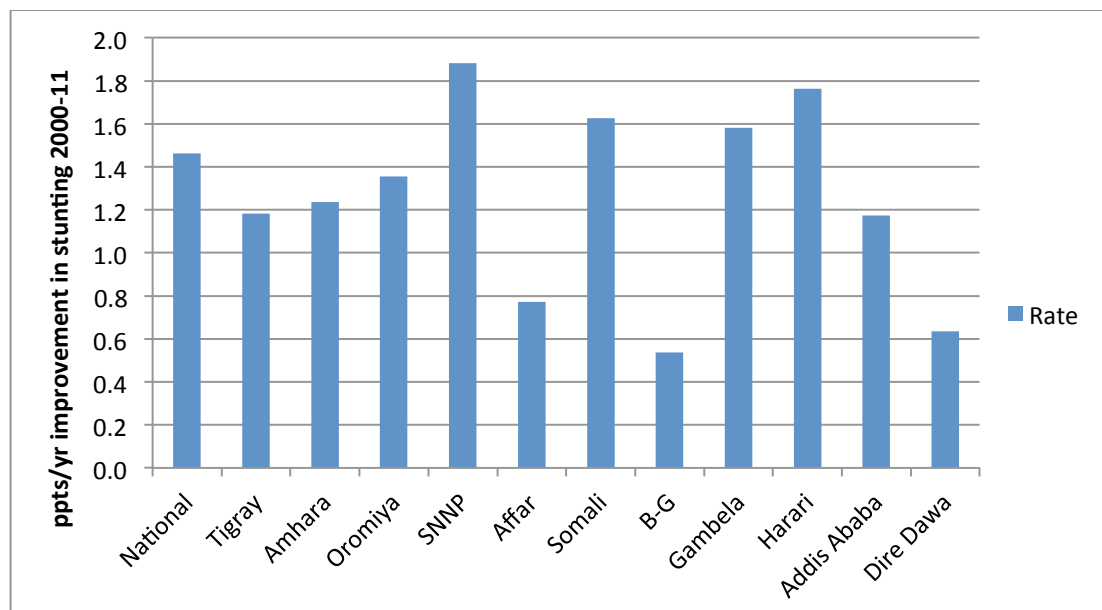
DHS is DHS results as published. Uncorrected is our estimates after cleaning data except for adjusting for lying/standing measurement issue. Corrected removes those cases incorrectly measured lying or standing (see Methods section).

Figure 2.8 Stunting prevalence (<-2SDs HAZ) in children 0-5 years, by region in Ethiopia, 2011.



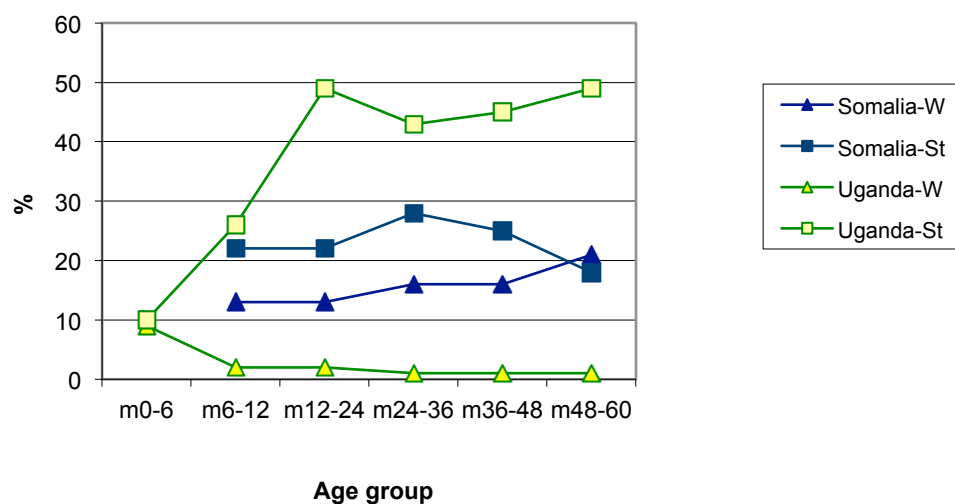
Source: calculated from cleaned DHS data (2011).

Figure 2.9 Rate of improvement (decrease) in stunting prevalence in children 0-5 years by region: in percentage points (ppts) per year, 2000-11.



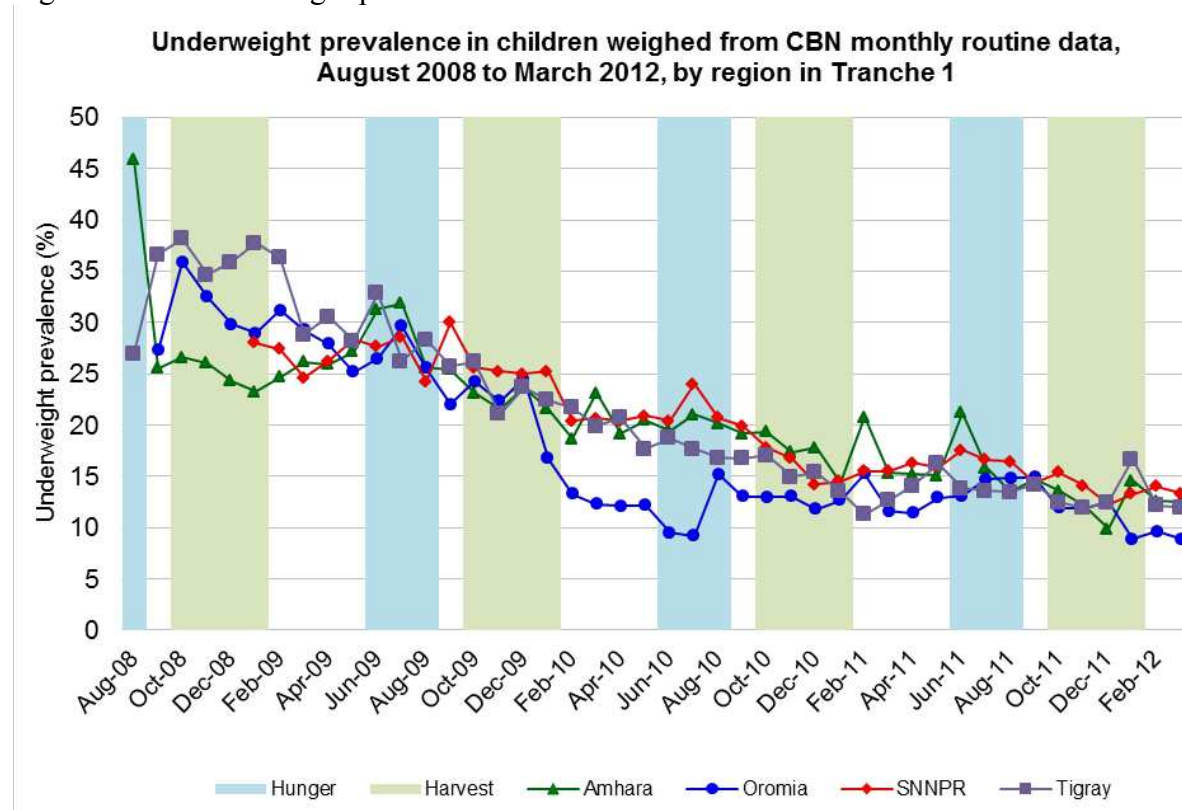
Source: calculated from cleaned DHS data (2000 and 2011).

Figure 2.10 Example of different growth patterns in children 0-5 years, for stunting (St) and wasting (W), by livelihood group: Somalia results are mainly for pastoralists, and Uganda are agriculturalists.



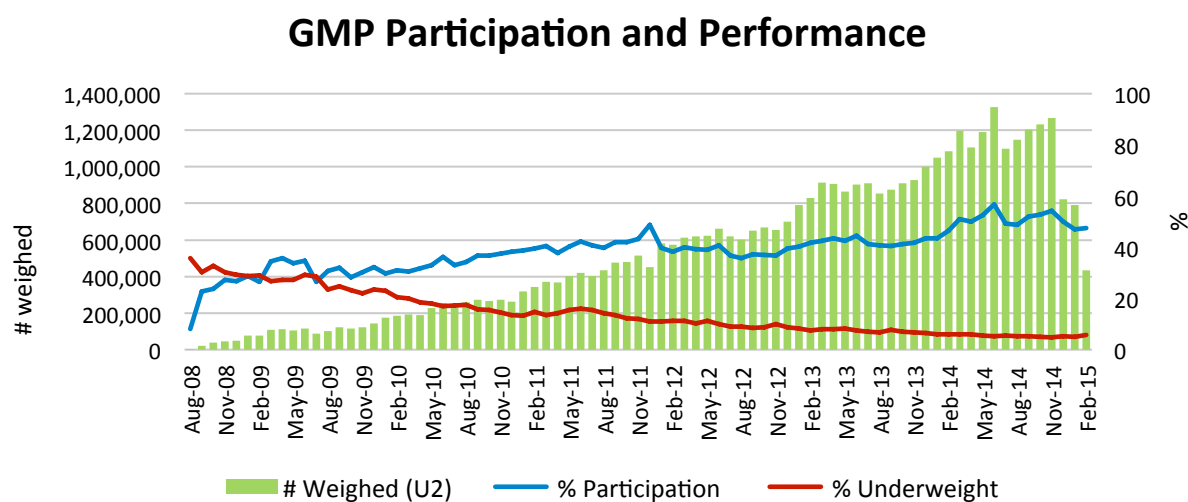
Source: Chotard S, Mason JB, Oliphant O, Mebrahtu S, Hailey P (2010) Fluctuations in wasting in vulnerable child populations in the Greater Horn of Africa. *Food and Nutrition Bulletin*, 31: 3, S219-233.

Figure 2.11 Underweight prevalence trends 2008-12 from CBN data



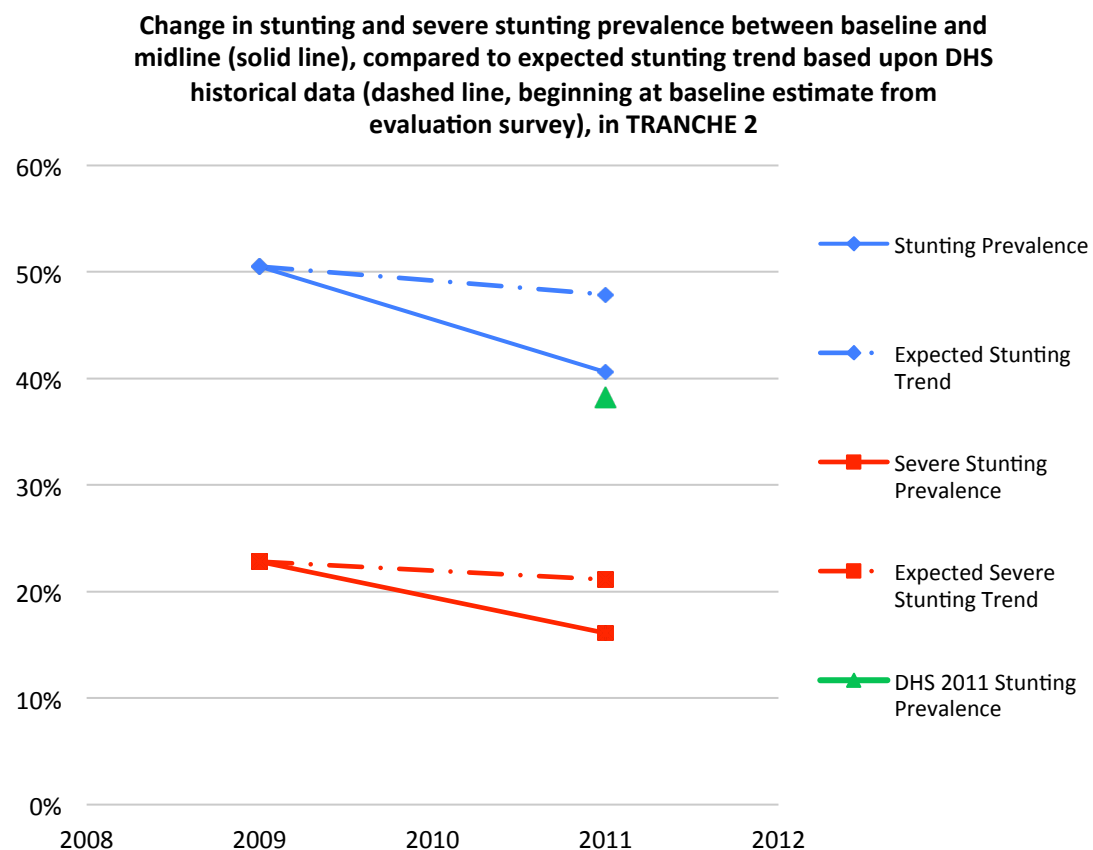
Source: Tulane calculations, in CBN compiled reports.

Figure 2.12 Trends in underweight and participation in growth monitoring, from weighing programme data, 2008-15.



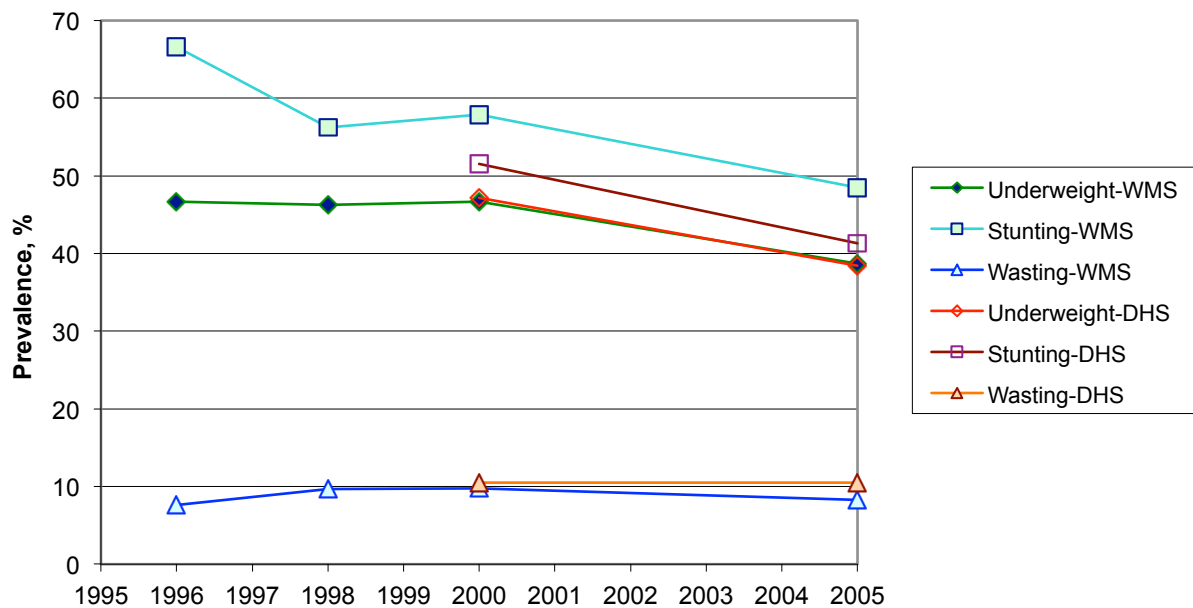
Source: UNICEF/FMoH nutrition database.

Figure 2.13 Results from CBN evaluation: changes in stunting with and without programme.



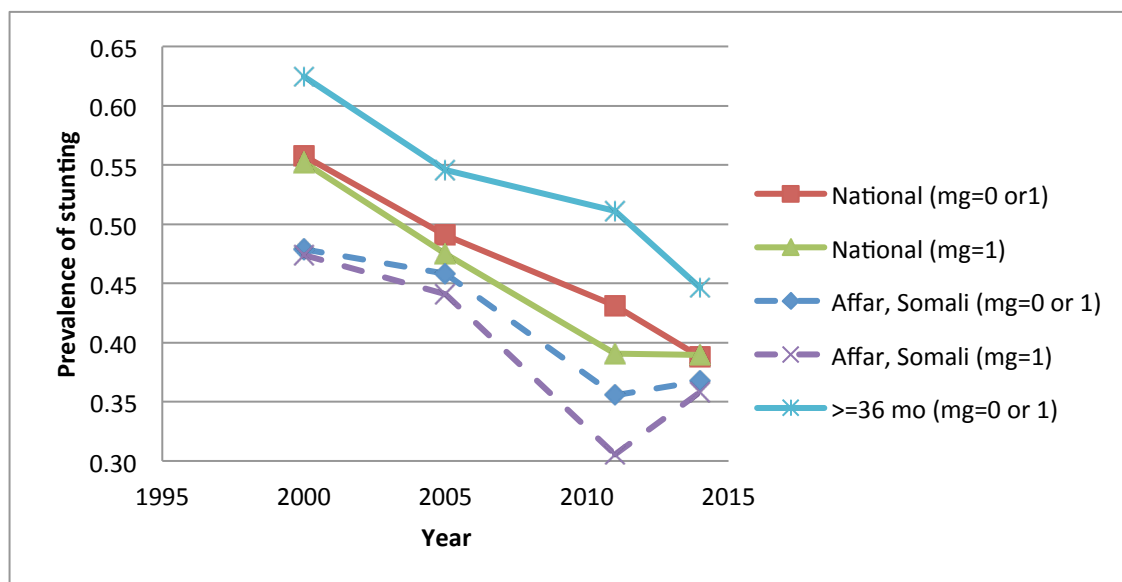
Source: White and Mason, 2012

Figure 2.14 Comparison of child malnutrition indicators in Ethiopia calculated from two survey sources, the Ethiopian Central Statistical Authority's Welfare Monitoring Surveys (1996-2005), and DHS (2000-5).



Source: 'Assessment of child nutrition in the Greater Horn of Africa.' Tulane report for UNICEF/ESARO, 2006.
Available on <http://tulane.edu/publichealth/internut/>

Figure 2.15 Stunting prevalences, national, and in Affar and Somali regions, 2000-14.



Note: 'mg' refers to the question of correct measurement of length, lying for children <24 months, and standing at 24 months and older; if this is wrong (above or below 24 months) then a variable 'mgood' = 0; if correct, mgood = 1; mg is short for mgood.

Figure 2.16 Underweight prevalences, national, and in Affar and Somali regions, 2000-14.

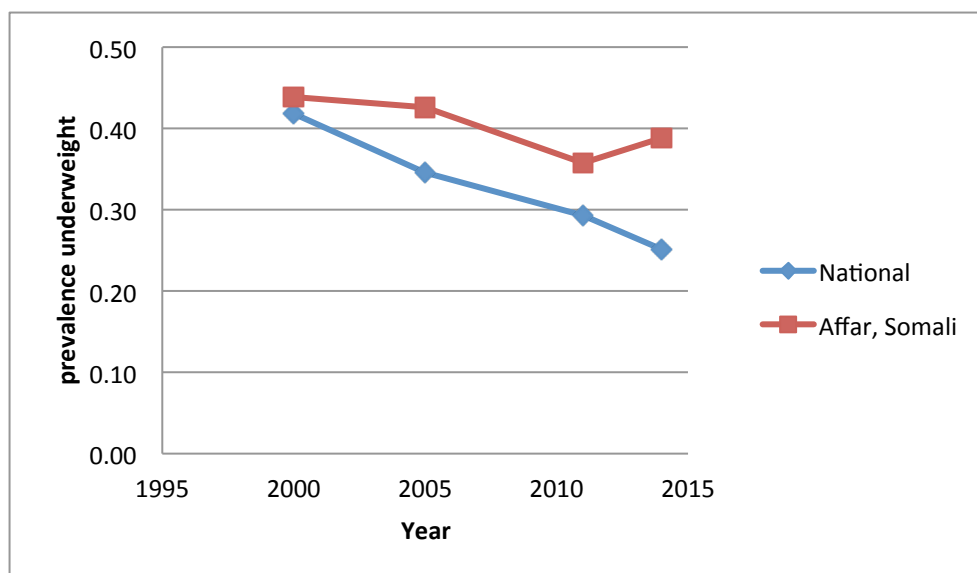


Figure 2.17 Comparison of stunting prevalences within 6 month age bands, by surveys 2000, -5, -11, -14: changes in patterns within age bands may indicate carry-over effects of drought.

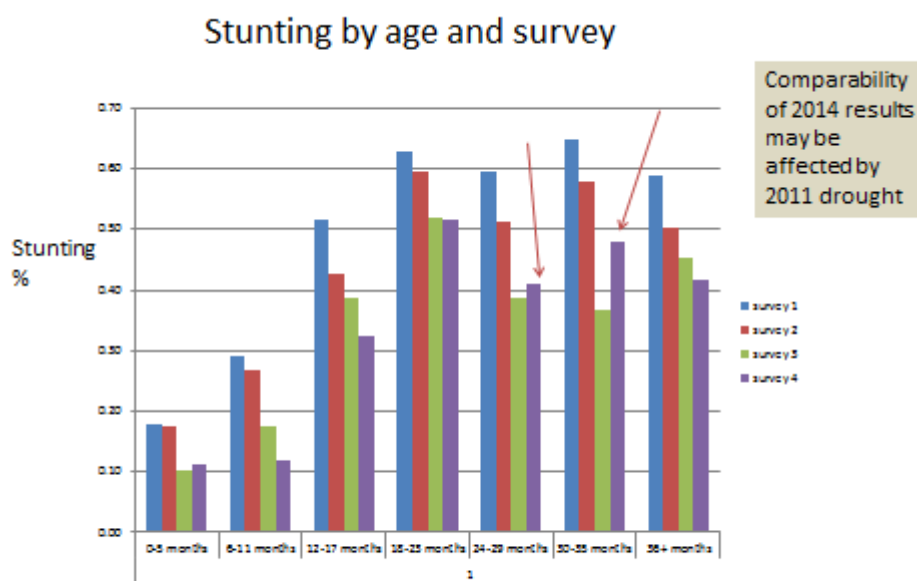


Figure 2.18 Changes in population proportions and prevalences of stunting, by maternal education.

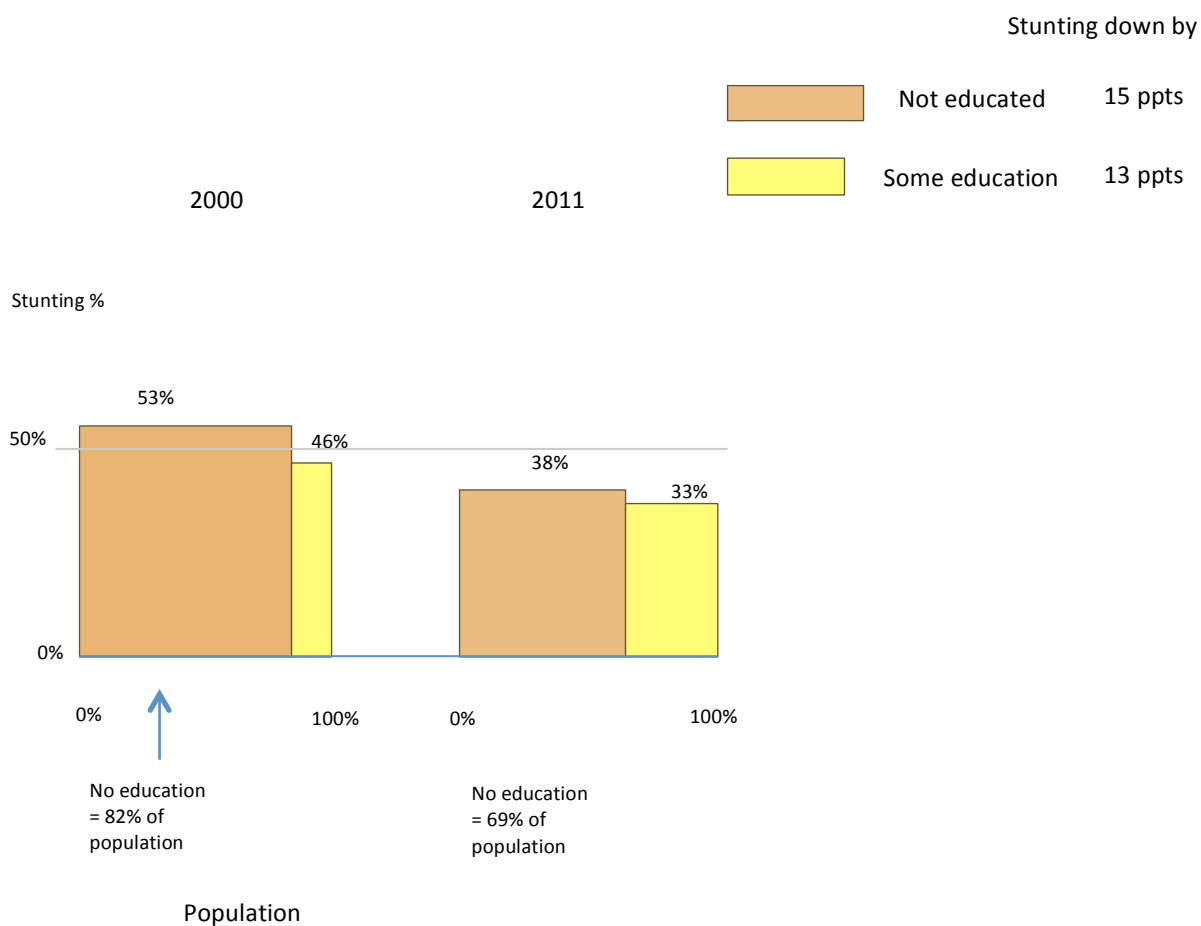
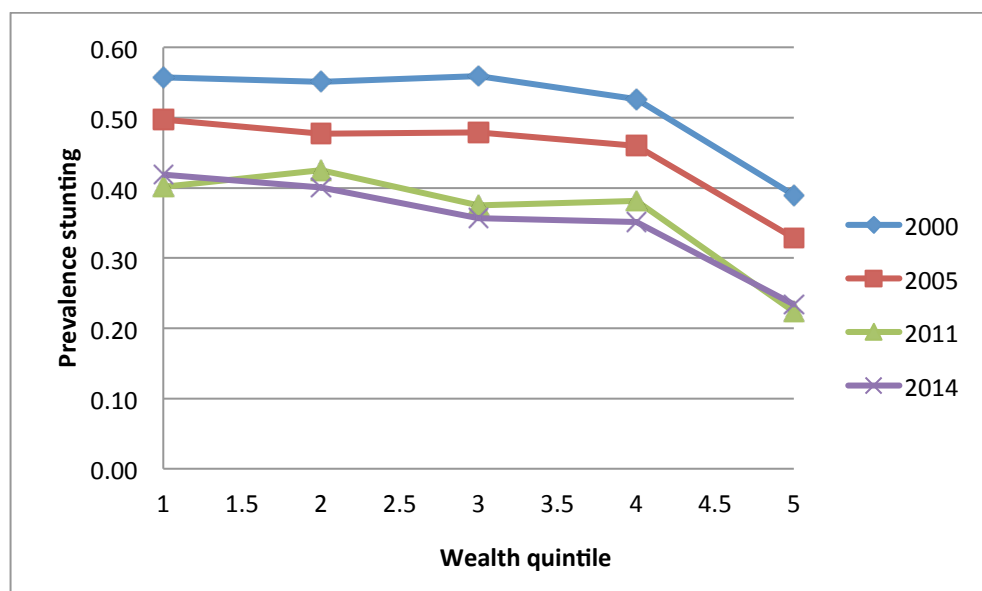
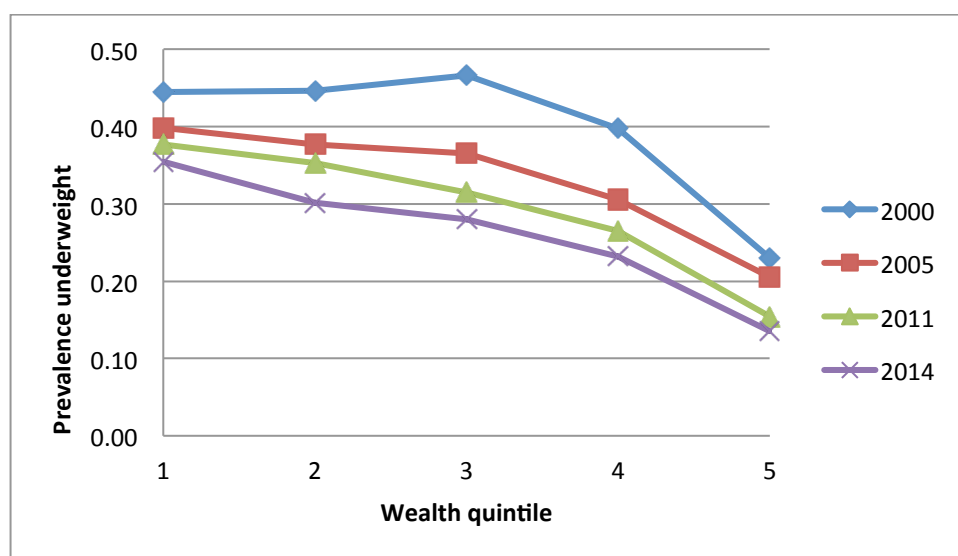


Figure 2.19 Prevalences of stunting by household's wealth quintile, 2000, -5, -11, -14 .



Note: wealth quintiles are calculated separately for each survey, from assets; the absolute wealth (or poverty) level in each quintile has generally improved within quintile over time, i.e. for example the 2011 quintile 1 is less asset poor than the 2000 quintile 1.

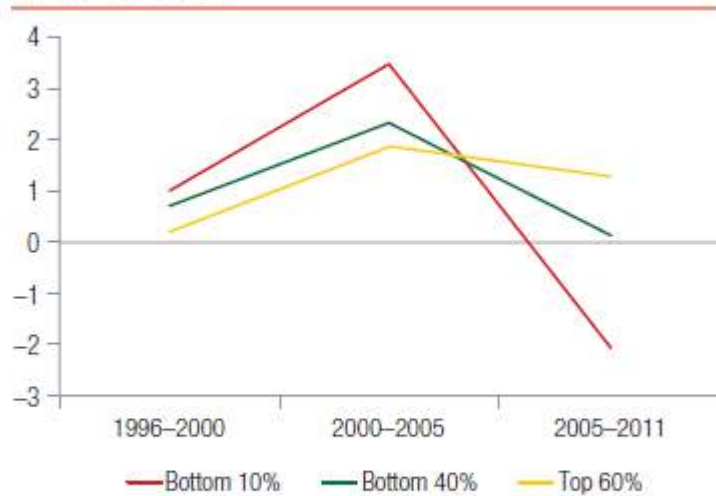
Figure 2.20 Prevalences of underweight by household's wealth quintile, 2000, -5, -11, -14 .



Note: wealth quintiles are calculated separately for each survey, from assets; the absolute wealth (or poverty) level in each quintile has generally improved within quintile over time, i.e. for example the 2011 quintile 1 is less asset poor than the 2000 quintile 1.

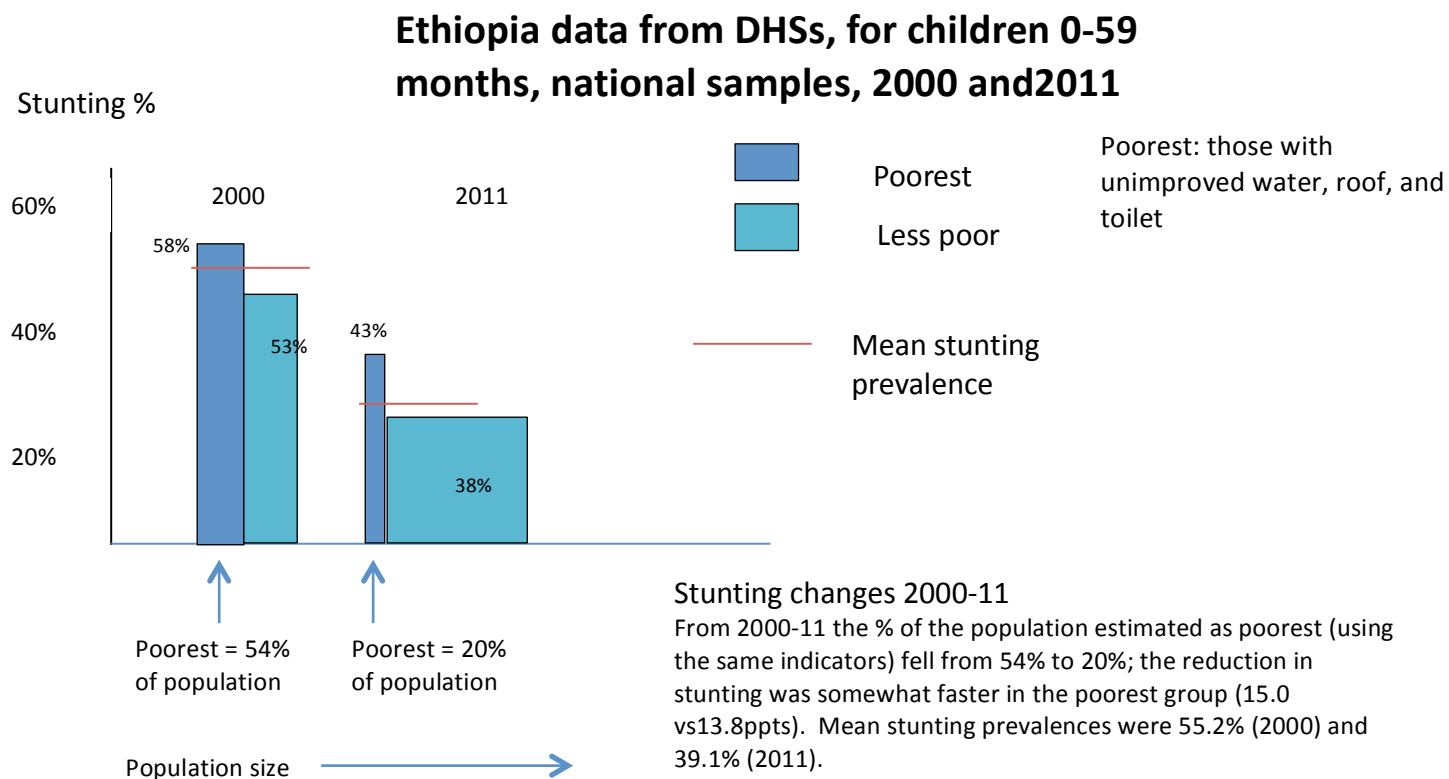
Figure 2.21 World Bank estimates of income growth by expenditure decile, 1996-2011.

FIGURE 1.8: Average growth for the bottom 10%, bottom 40% and the top 60% from 1995 to 2011



Source: Own calculations using HICES 1996, HICES 2000, HICES 2005 and HICES 2011.

Figure 2.22 Changes in population proportions and prevalences of stunting, by absolute asset poverty level (no assets vs some).



Source: calculated from DHS 2000-11 data, Tulane SPHTM, 19 Feb 2015

Figure 2.23 Stunting prevalence trends 2000-11 by region and poverty category (zero-assets vs some assets).

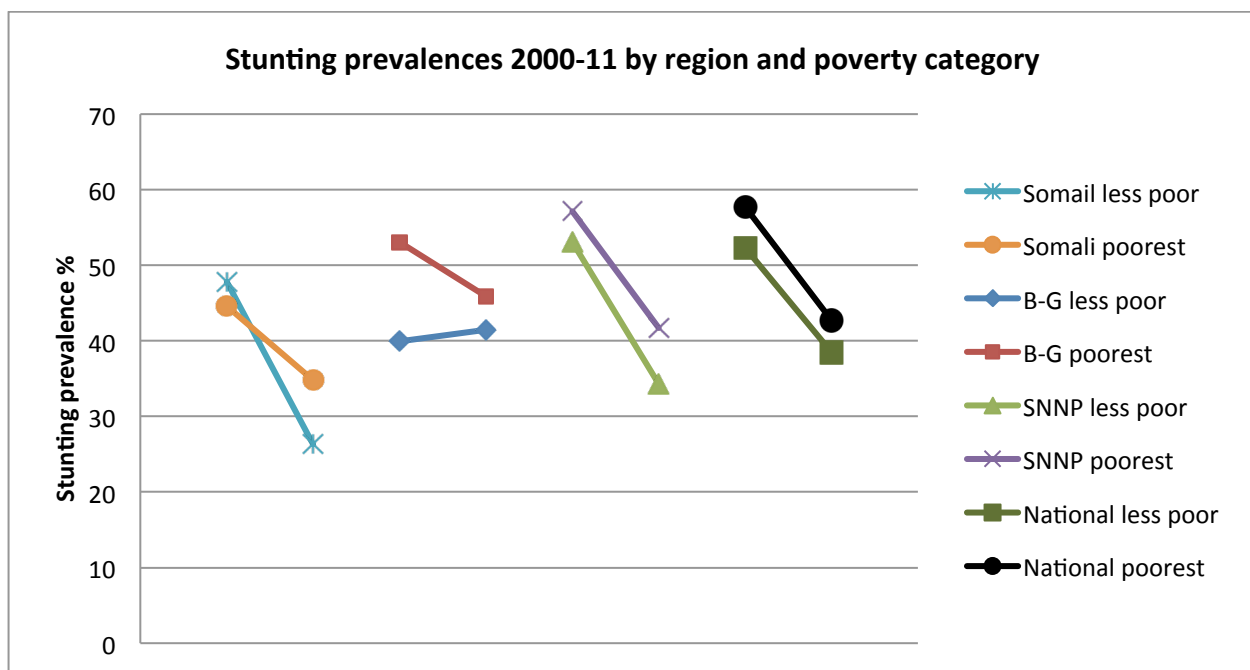
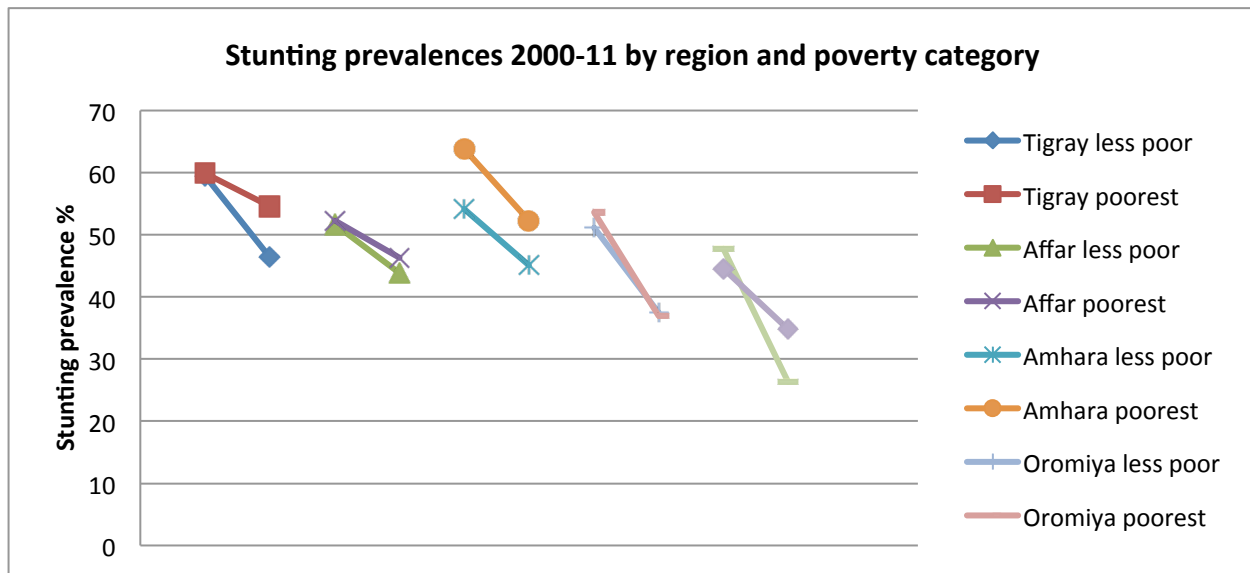
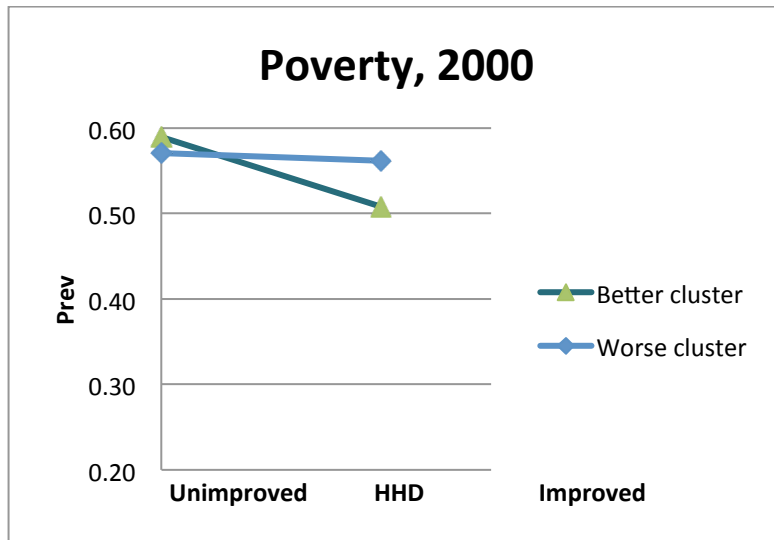
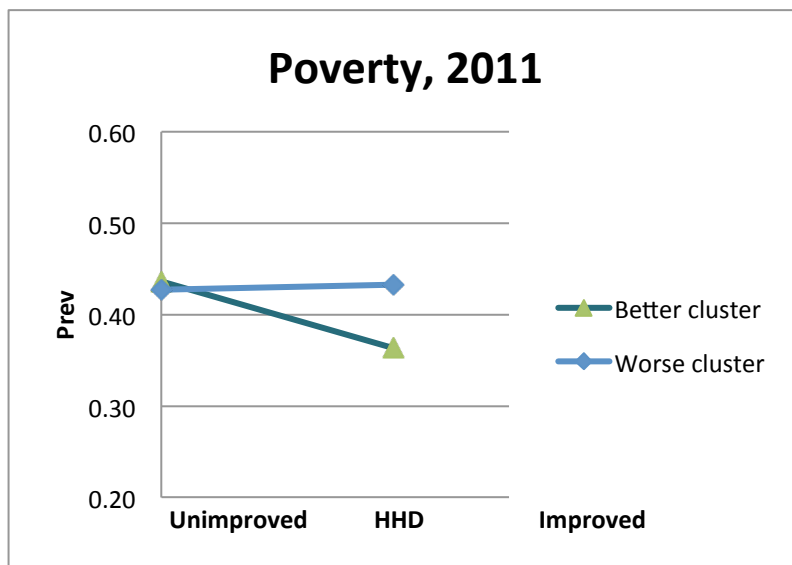


Figure 2.24 Interactions of poverty with stunting, at cluster and household levels, 2000 and 2011 DHS surveys.



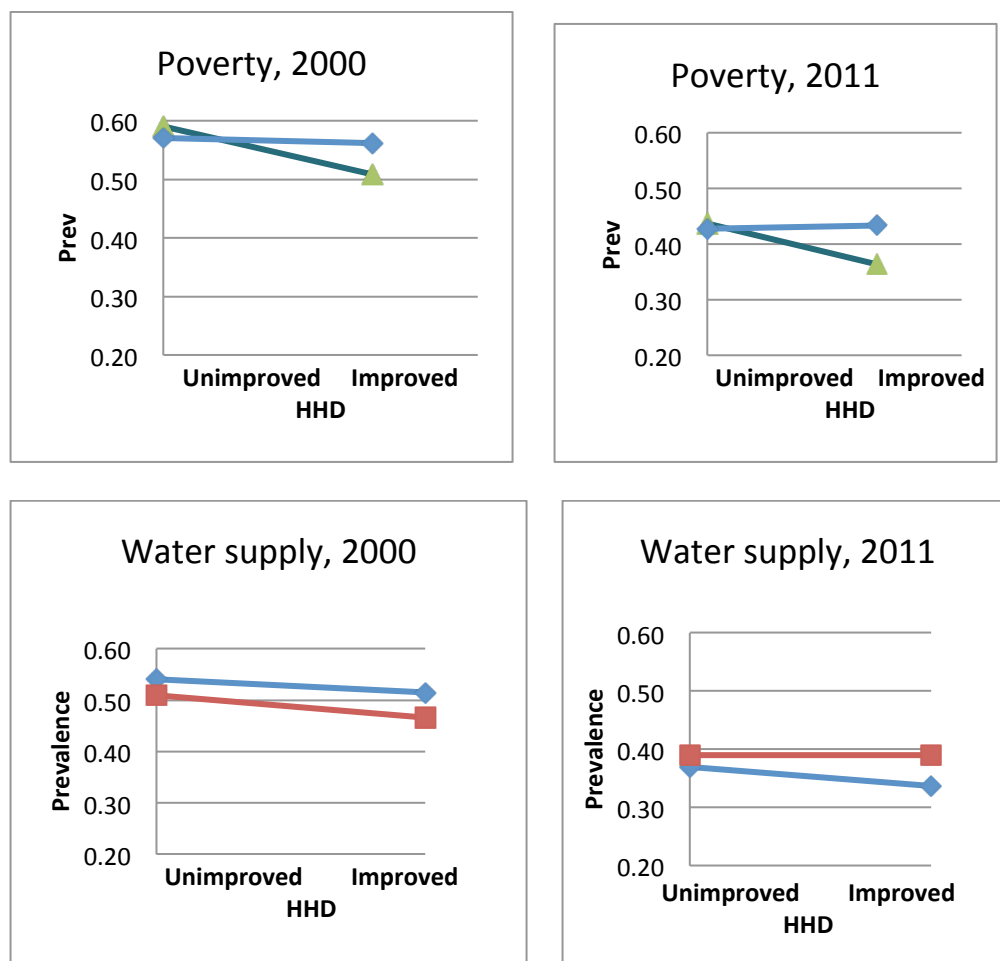
Interaction: $p=0.01$



Interaction: $p=0.003$

Figure 2.25 Interactions with stunting of poverty, water supply, sanitation, education, and roofing.

Note: the two lines in each graph are: higher is always for the worst-off clusters, lower for the better-off, in terms of %s with zero-asset absolute poverty.



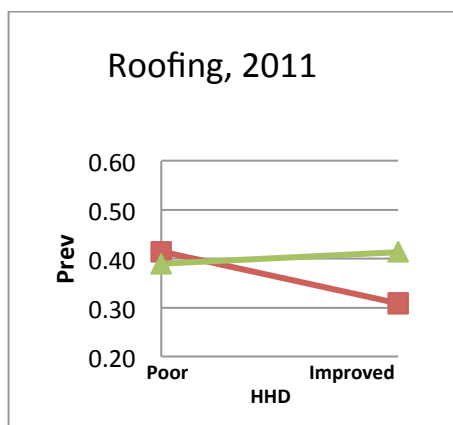
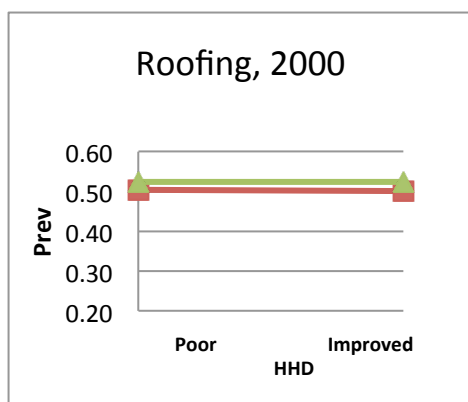
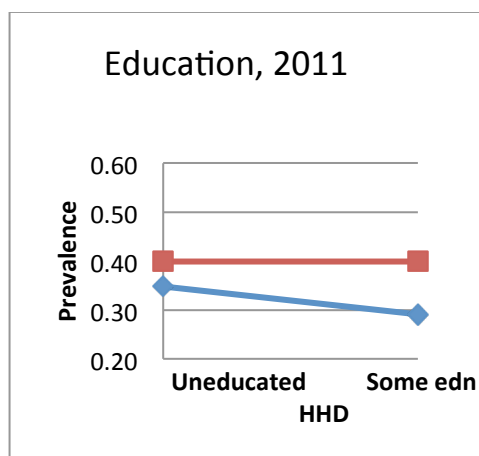
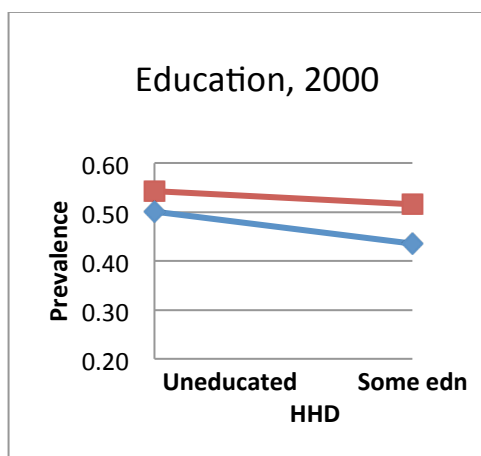
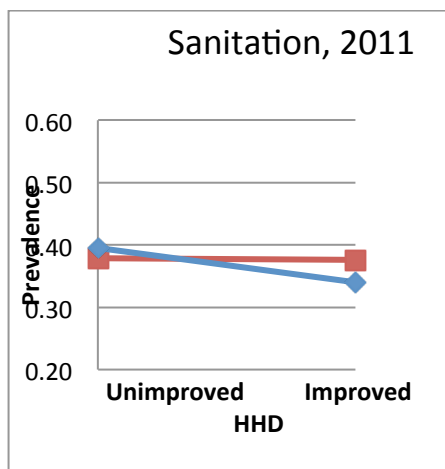
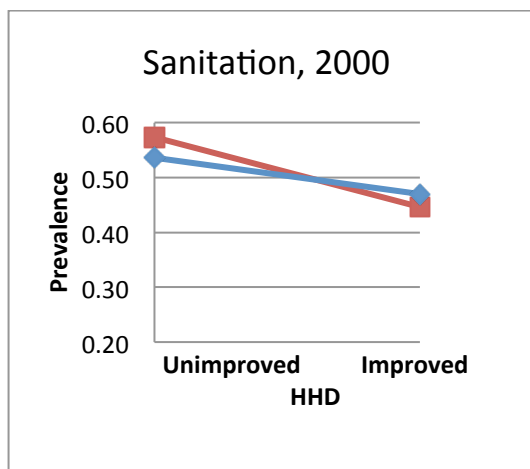


Figure 2.26 HAZ score by categories of age at first birth and age of child in Ethiopia

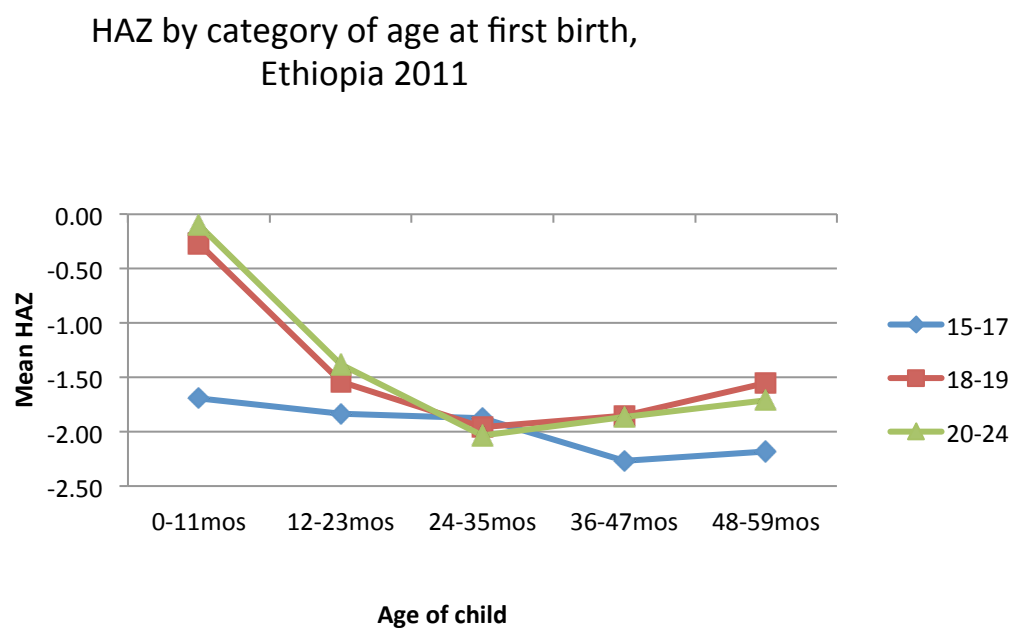
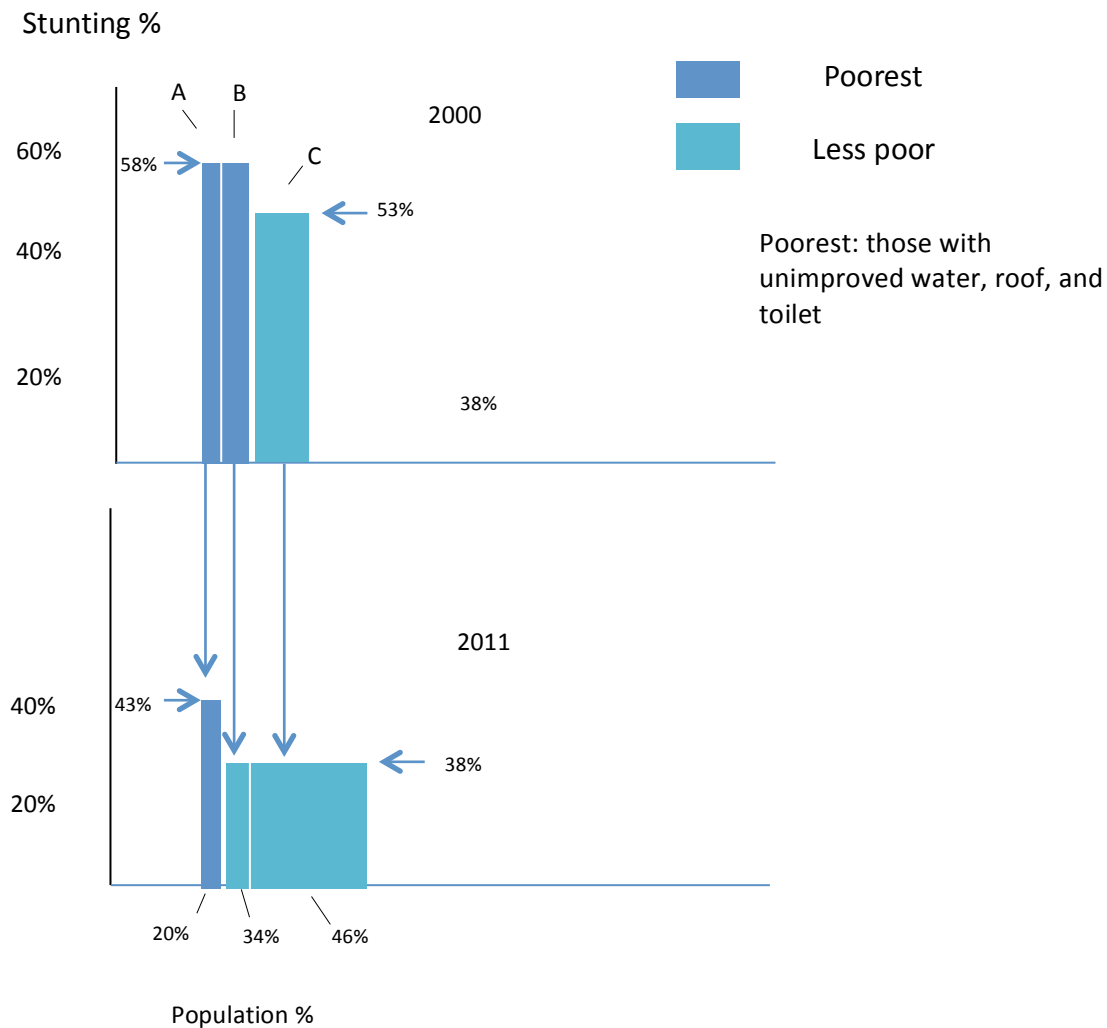


Figure 2.27 Illustration of how stunting reduction due to underlying trend and due to % of population in poverty could combine.

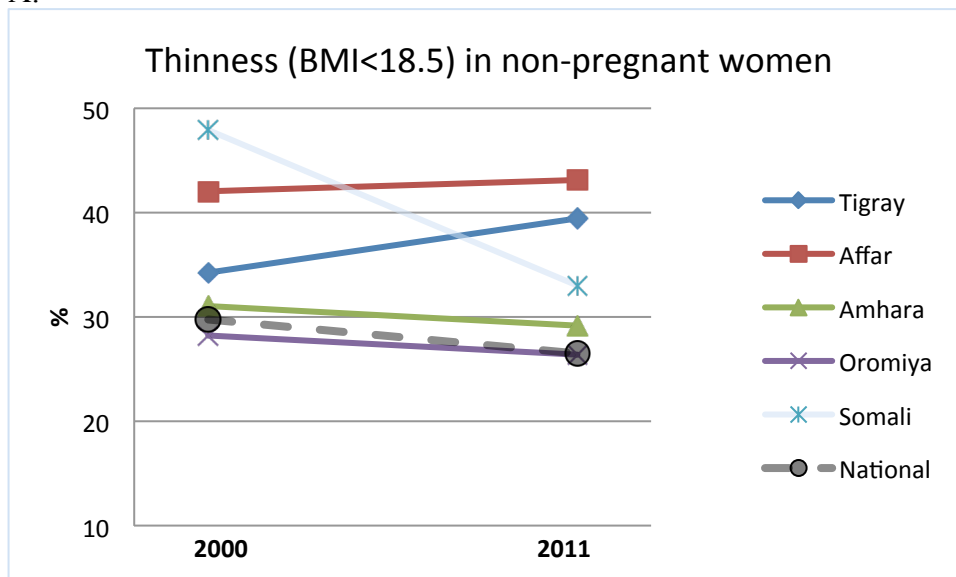


For description of calculation see text in section 'How do trends by vulnerable group relate to cross-sectional correlations?'

Source: calculated from data in previous figure

Figure 2.28 Trends in low BMI prevalences (< 18.5) in non-pregnant women, 2000-11, by region.

A.



B.

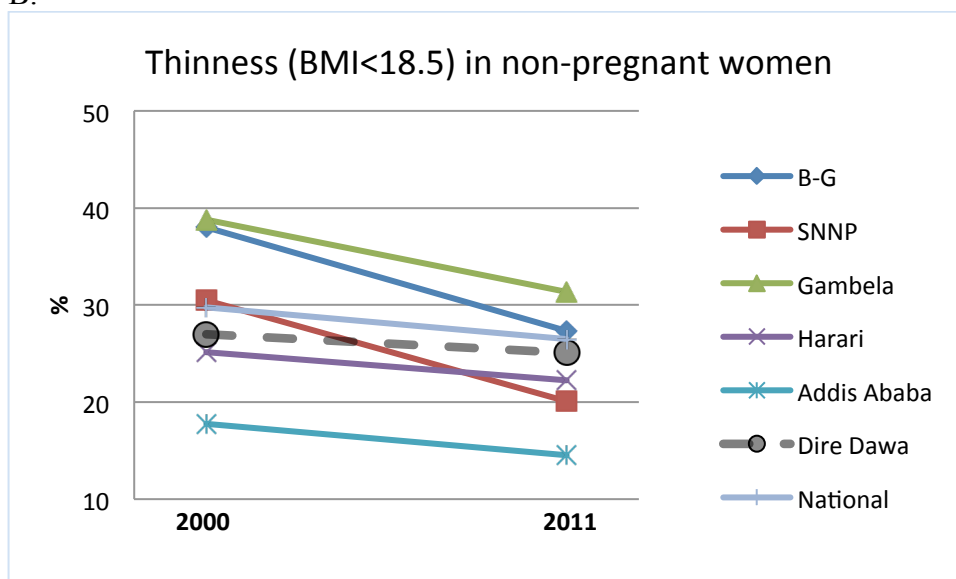
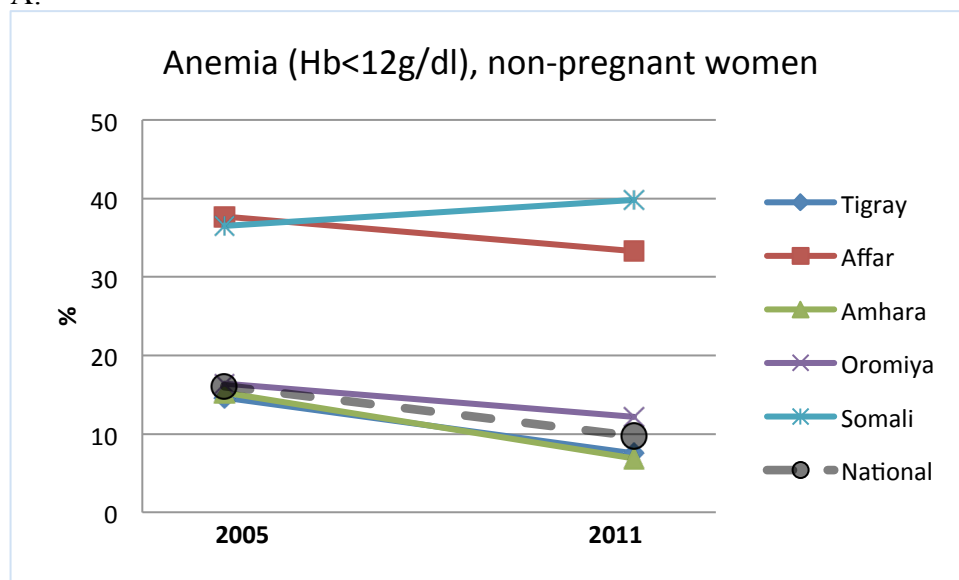


Figure 2.29 Trends in anemia by region in non-pregnant women, 2005-11.

A.



B.

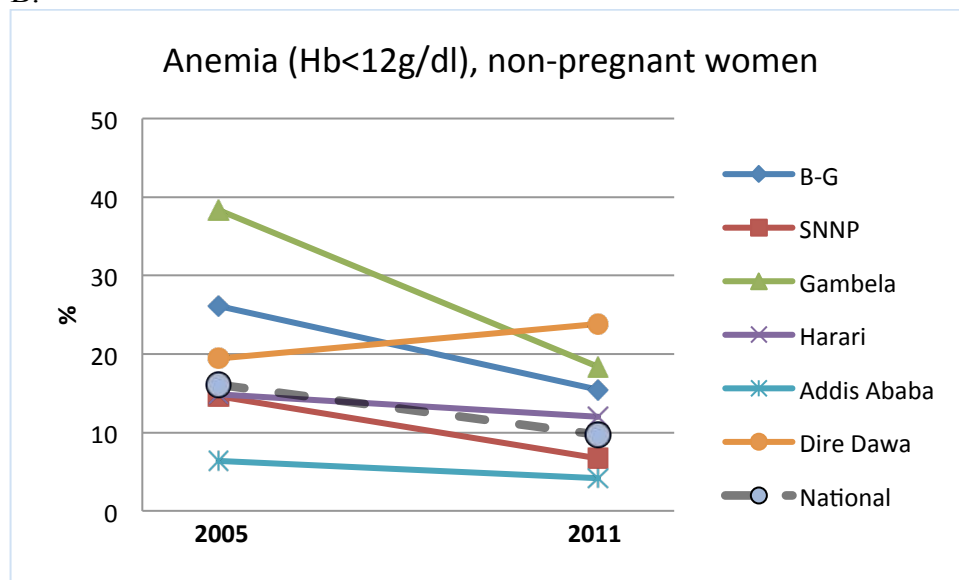
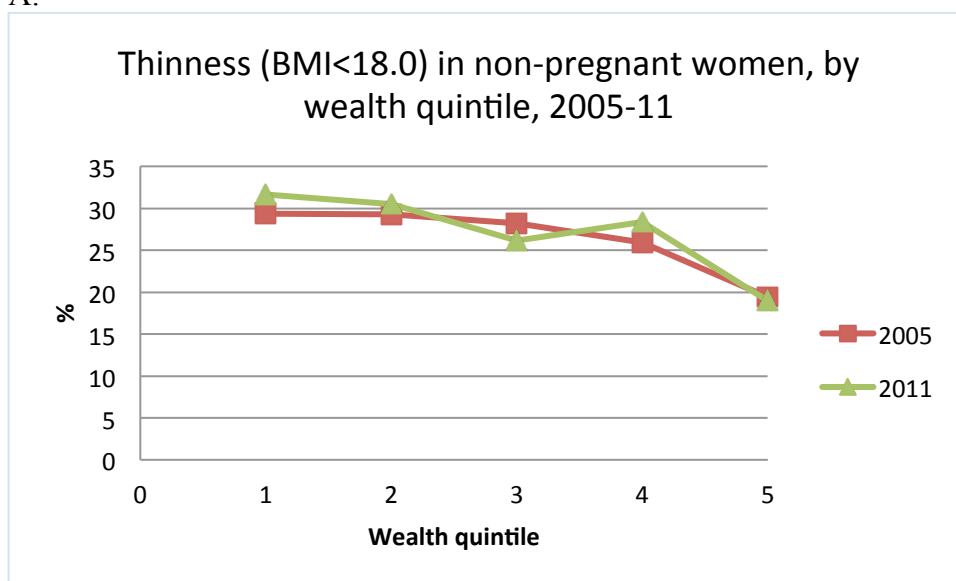


Figure 2.30 Relations of women's malnutrition (BMI < 18.5, and anemia, Hb < 12.0 g/dl) with relative wealth quintiles, 2005 and 2011.

A.



B.

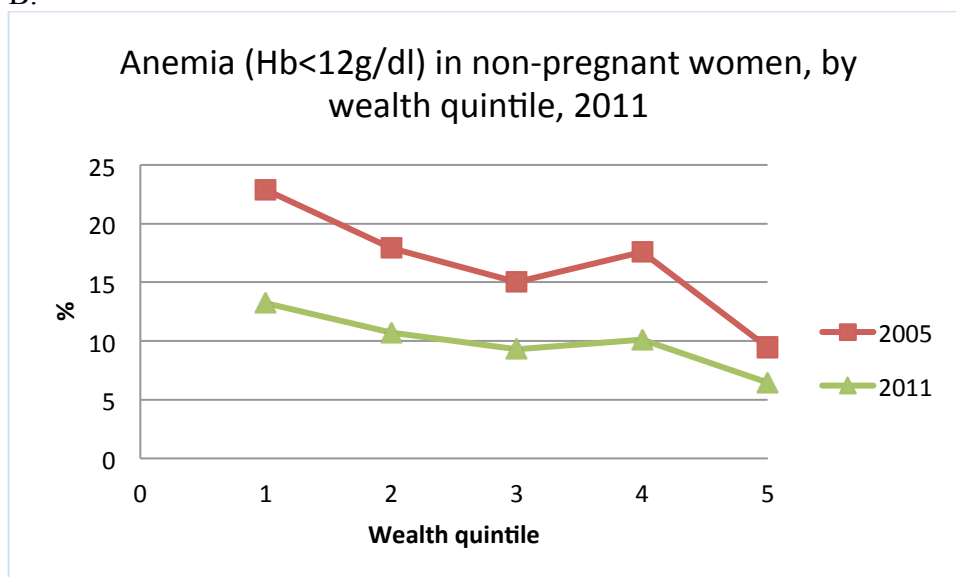
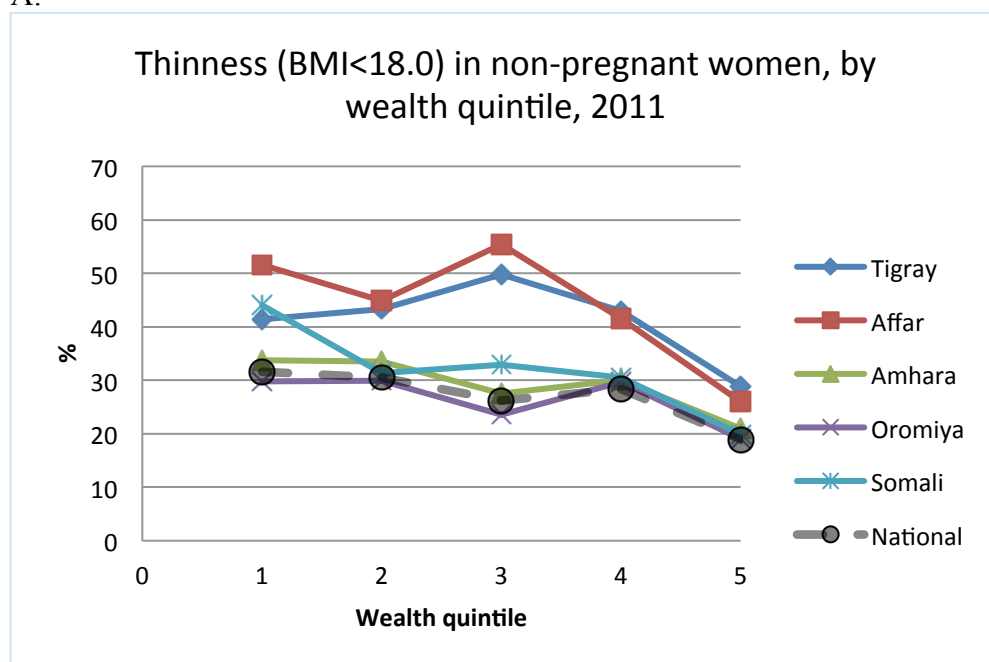


Figure 2.31 Thinness in non-pregnant women by region and wealth quintile, 2011.

A.



B.

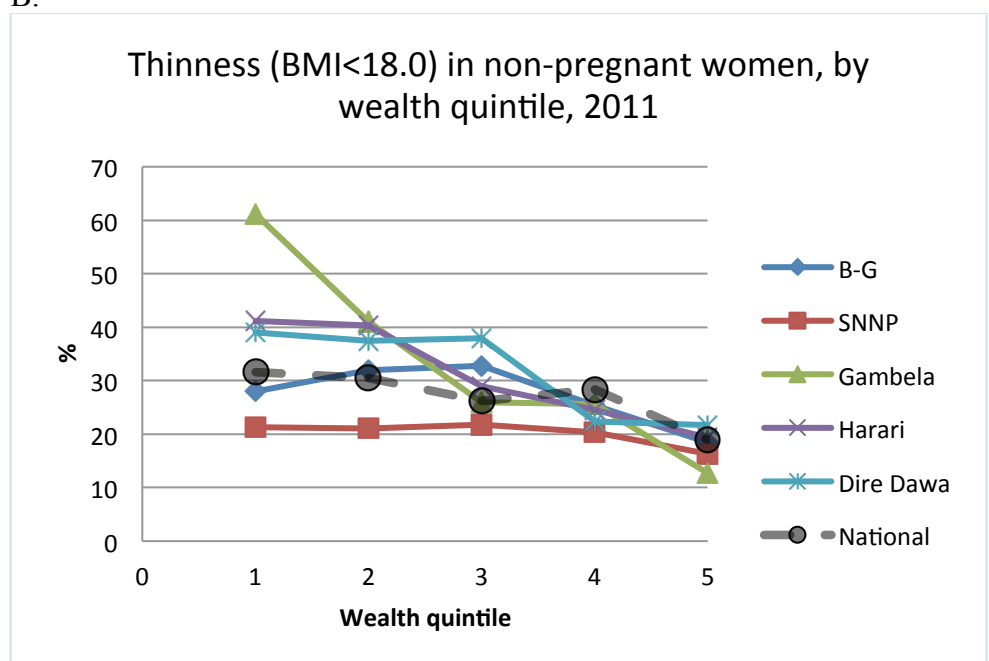
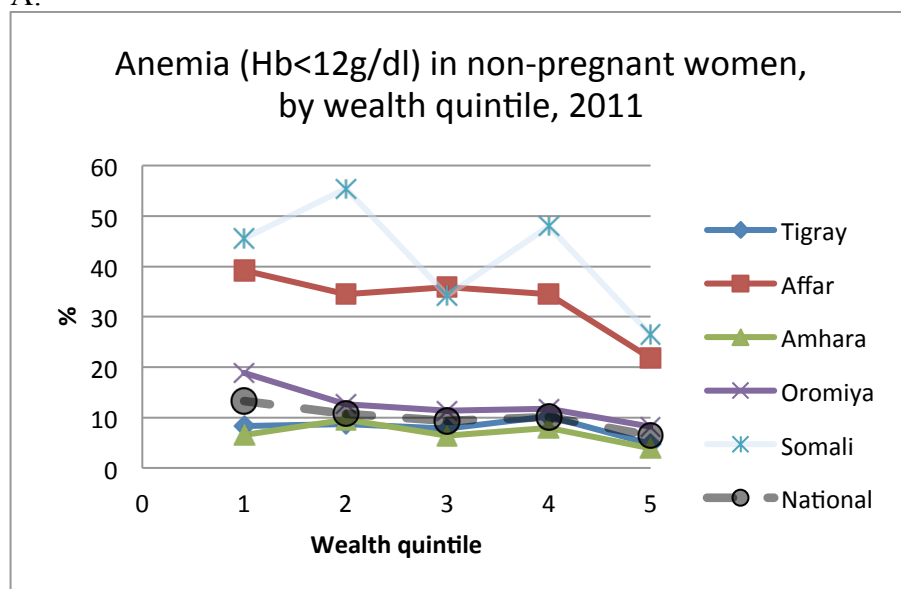


Figure 2.32 Anemia in non-pregnant women, by region and wealth quintile.

A.



B.

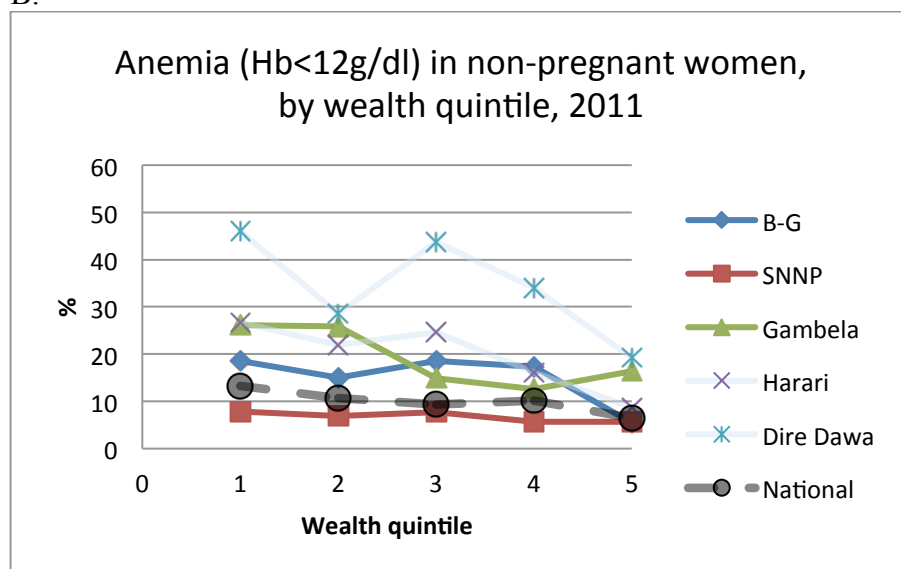
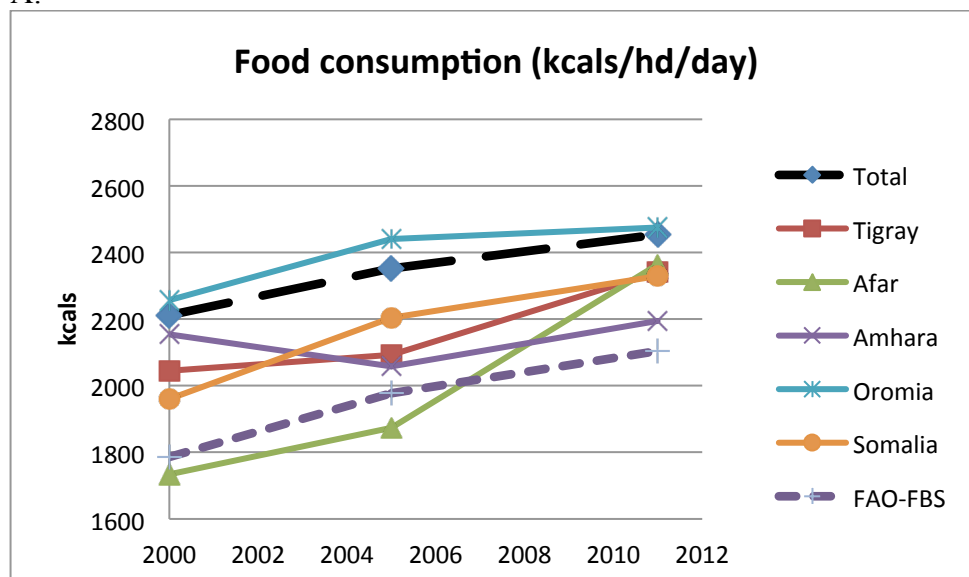
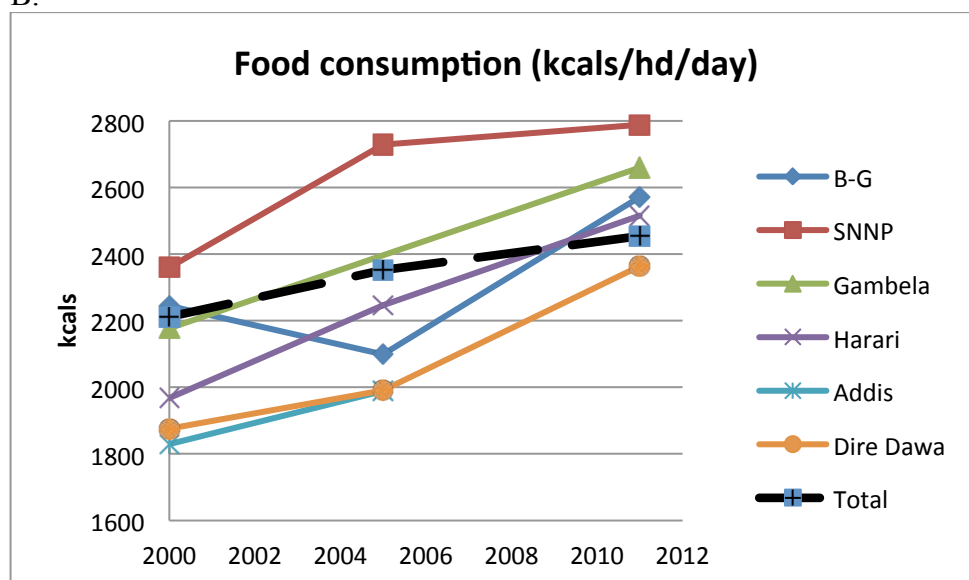


Figure 2.33 Food consumption estimates, kcals/capita/day, by region, 2000-2011.

A.

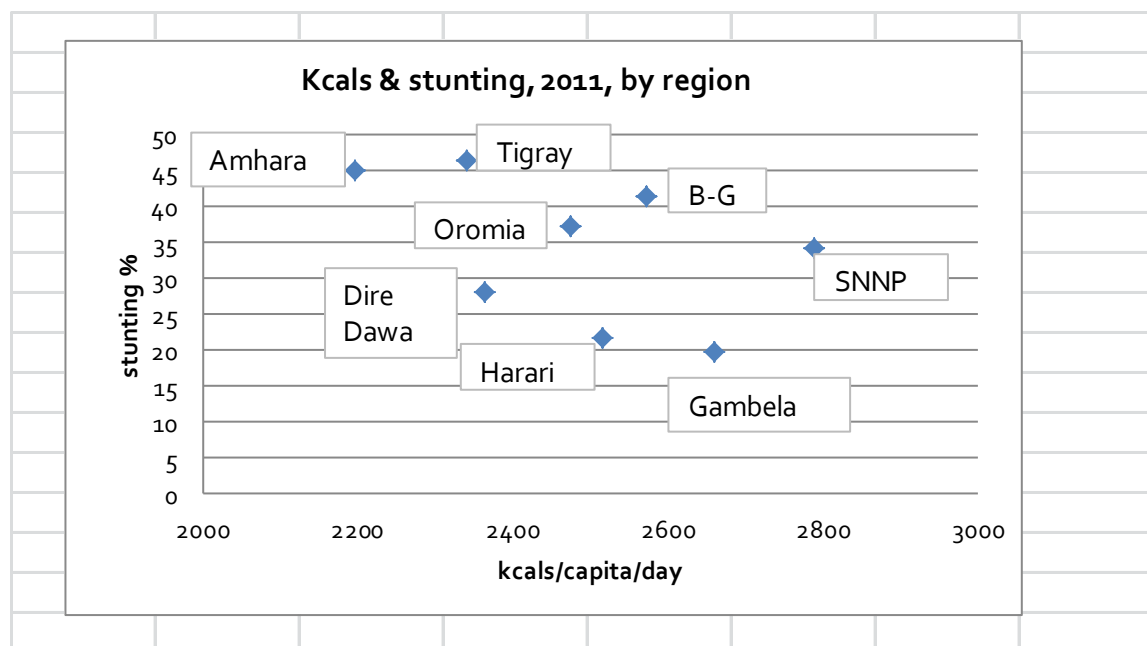


B.



Source: HICE 2012 Analytical, table 37.

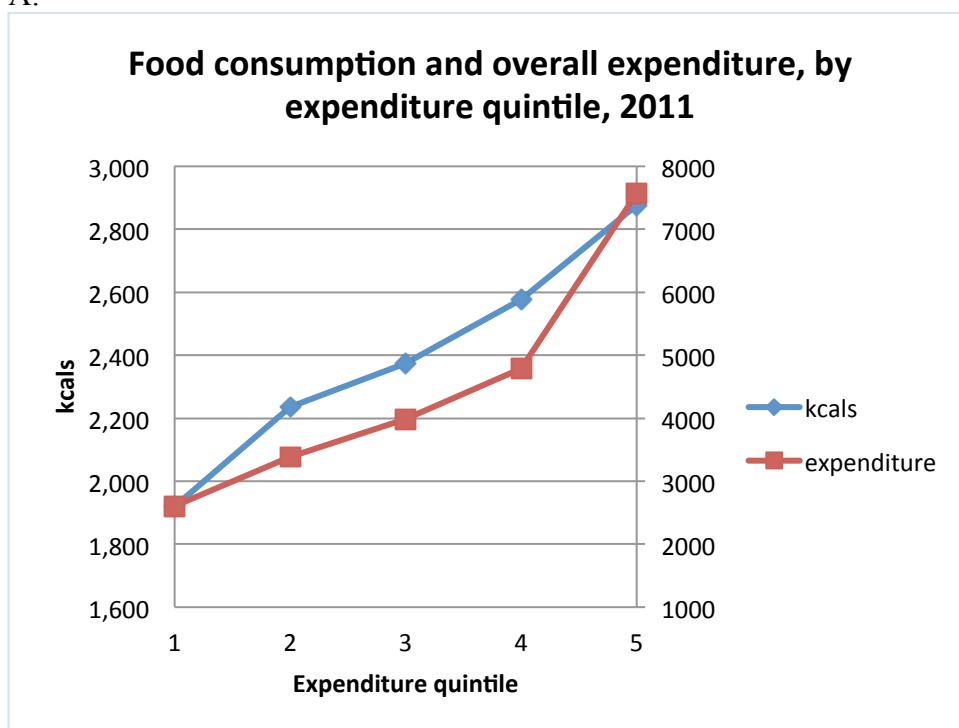
Figure 2.34 Child malnutrition (stunting) and food consumption (kcal/capita/day), by region, 2011.



Calculated from data presented elsewhere.

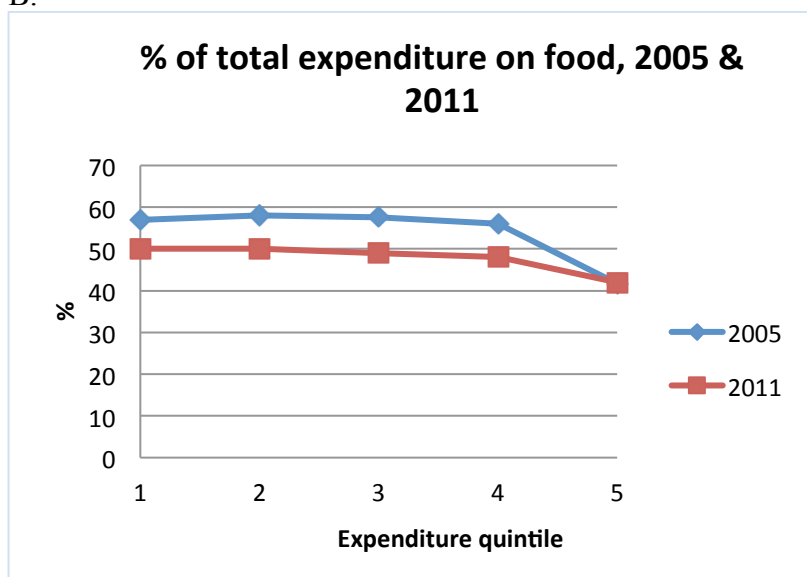
Figure 2.35 Food consumption and expenditure, 2011.

A.



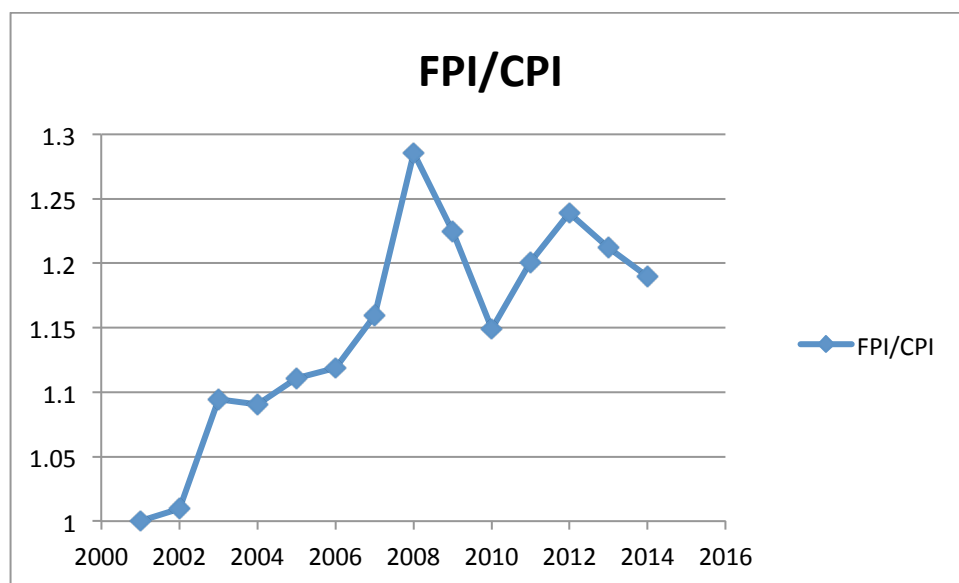
Source: HICE 2012 Vol II, t B.10.1.a, Vol I t 26.

B.



Source: HCE 2012 t26, HCE 2005 t 3.14

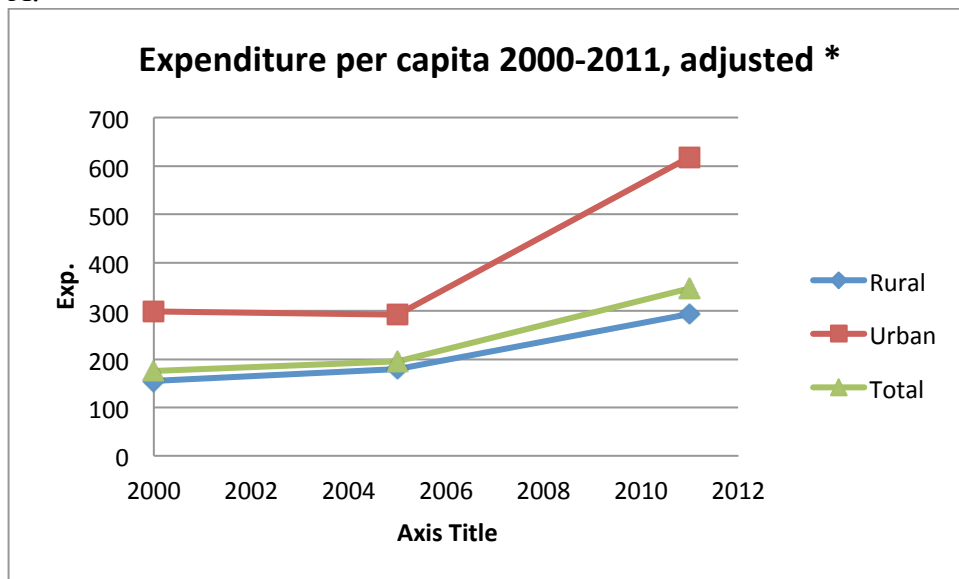
Figure 2.36 Relative price index of food, 2000-2014.



Source: calculated from FAOSTAT data

Figure 2.37 Expenditure and income, 2000, -5, -11.

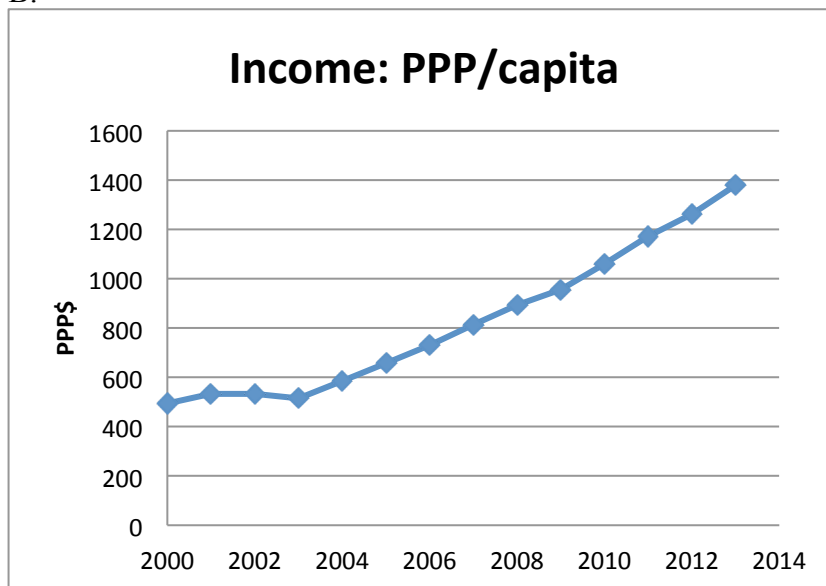
A.



Source: HCE 2012 t24

* adjusted by birr:US\$ exchange rate

B.



Source: <http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD>

Figure 2.38 Health and hygiene data from 2011 Welfare Monitoring Survey.

A

Table 9 Illness Episode Over the Five Survey Years

YEAR	COUNTRY			RURAL			URBAN		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
1998	33.8	36.3	35.1	35.2	37.6	36.4	24.8	29.0	27.1
2000	25.9	28.4	27.2	27.2	29.7	28.4	17.5	21.2	19.5
2004	22.4	25.1	23.8	23.1	26.0	24.6	17.7	20.3	19.1
2011	15.2	18.6	16.9	15.5	18.9	17.2	13.6	17.1	15.5

Illness episode generally has shown a declining trend over the last four survey years regardless of the place of residence and sex of an individual.

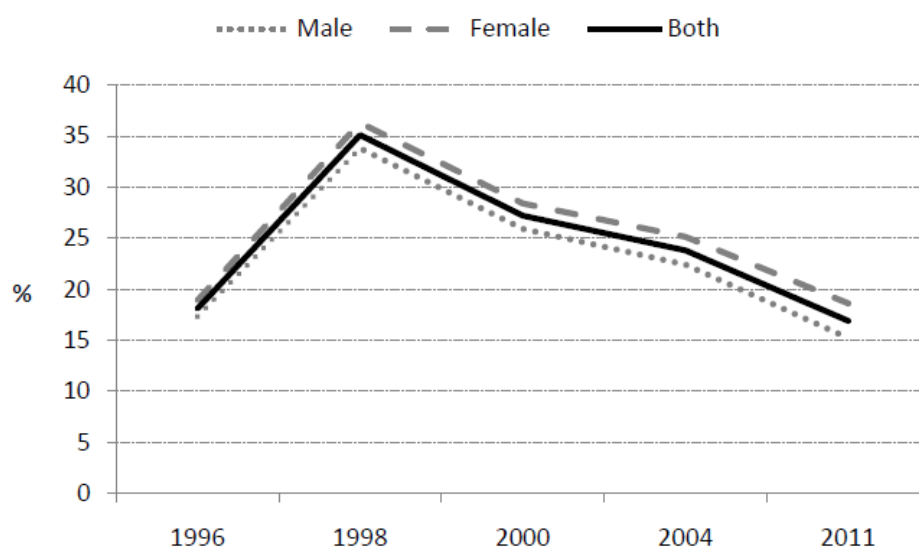


Figure 2 Trends in illness Episode

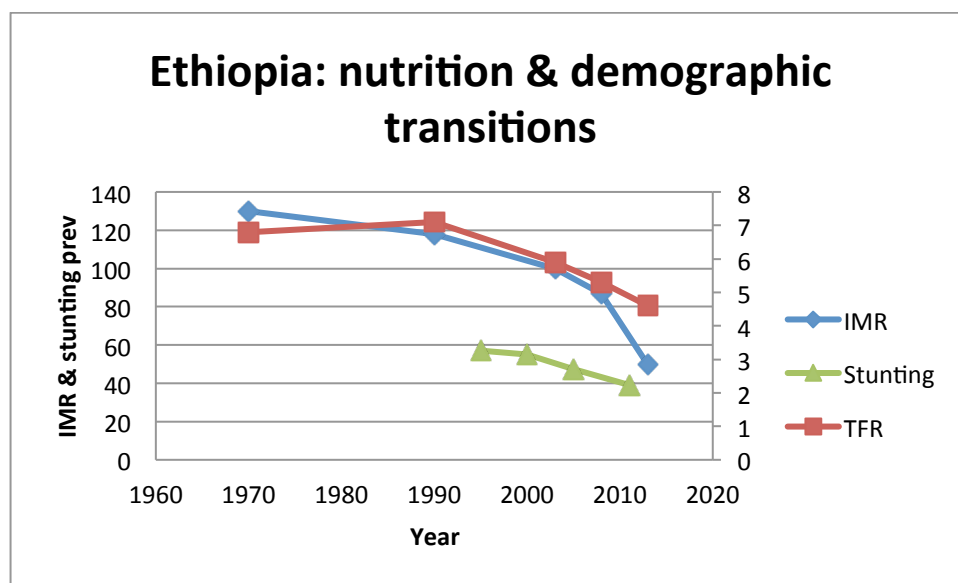
B.

Table 17 Type of toilet facility, urban and rural households 1996, 1998, 2000, 2004, 2011

RESIDENCE/ TYPE OF TOILET	1996	1998	2000	2004	2011
TOTAL					
Flush Toilet	0.9	1.4	1.7	2.5	2.2
Pit Latrine	12.1	14.6	16.3	28.1	63.8
Container	0.1	0.3	0.1	0.2	0.1
Field/Forest	84.4	83.3	81.5	68.9	33.7
Others	2.5	0.4	0.5	0.2	0.2
RURAL					
Flush Toilet	0.6	0.9	0.8	1.3	0.1
Pit Latrine	4.4	6.6	8.1	20.0	60.3
Container	0.1	0.2	0.0	0.2	0.0
Field/Forest	92.0	92.0	90.7	78.2	39.5
Others	2.9	0.4	0.4	0.2	0.0
URBAN					
Flush Toilet	2.4	4.4	7.0	8.8	10.0
Pit Latrine	55.6	63.3	64.6	71.4	76.8
Container	0.2	0.9	0.7	0.3	0.2
Field/Forest	41.7	30.6	26.9	19.2	12.5
Others	0.2	0.8	0.8	0.3	0.0

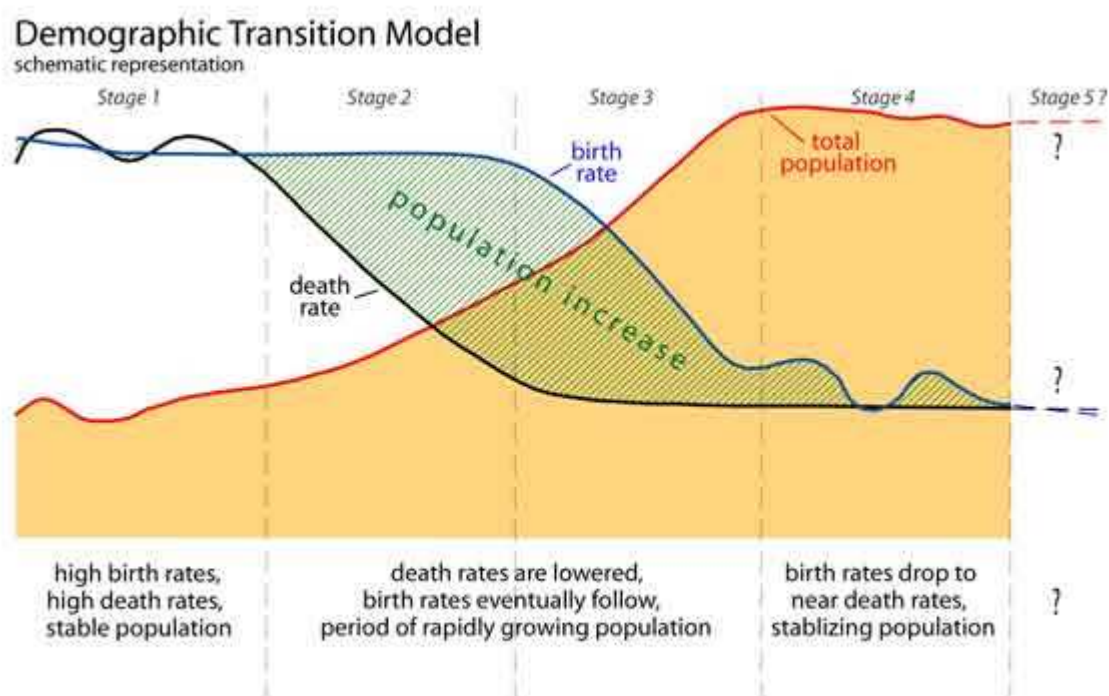
Source: WMS 2011

Figure 2.39 Trends in stunting, IMR, and total fertility rate (TFR), 1970 – 2015.



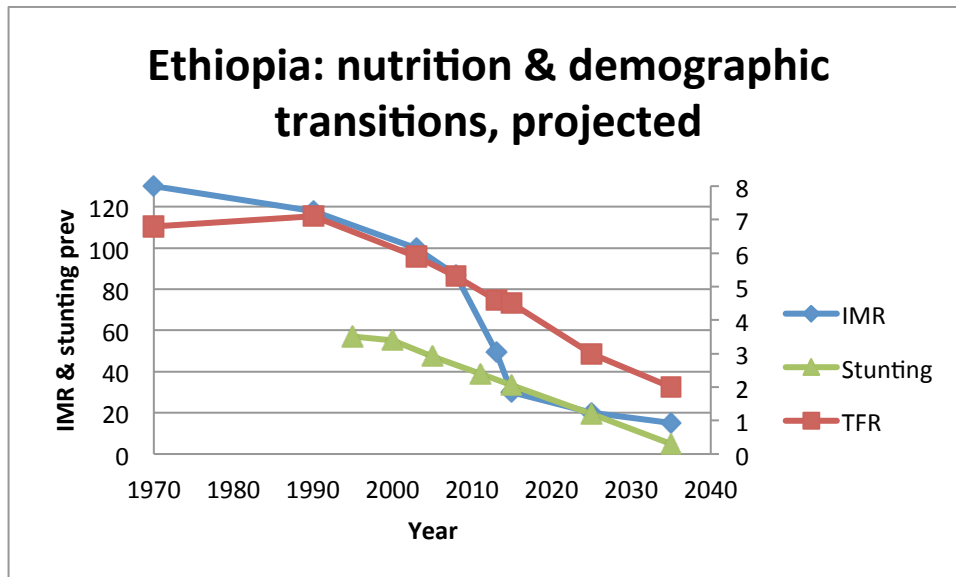
Sources: UNICEF SOWCs; DHS.

Figure 2.40 Standard demographic transition model.



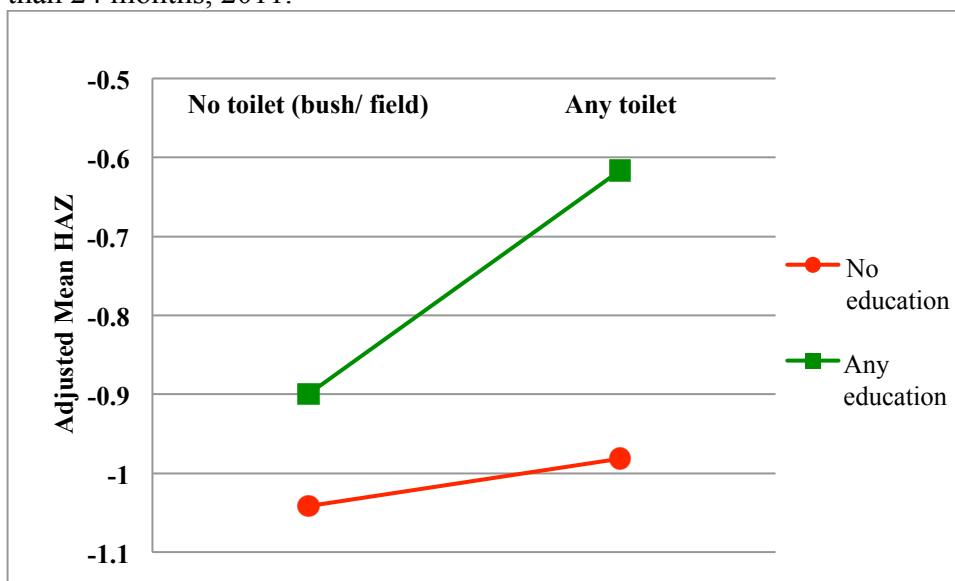
Source: http://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id=71

Figure 2.41 Projections relevant to demographic and nutrition transitions.



2.C Risk factors: WASH – Figures

Figure 2.42 Interaction: Adjusted mean height-for-age by toilet and education, ages less than 24 months, 2011.

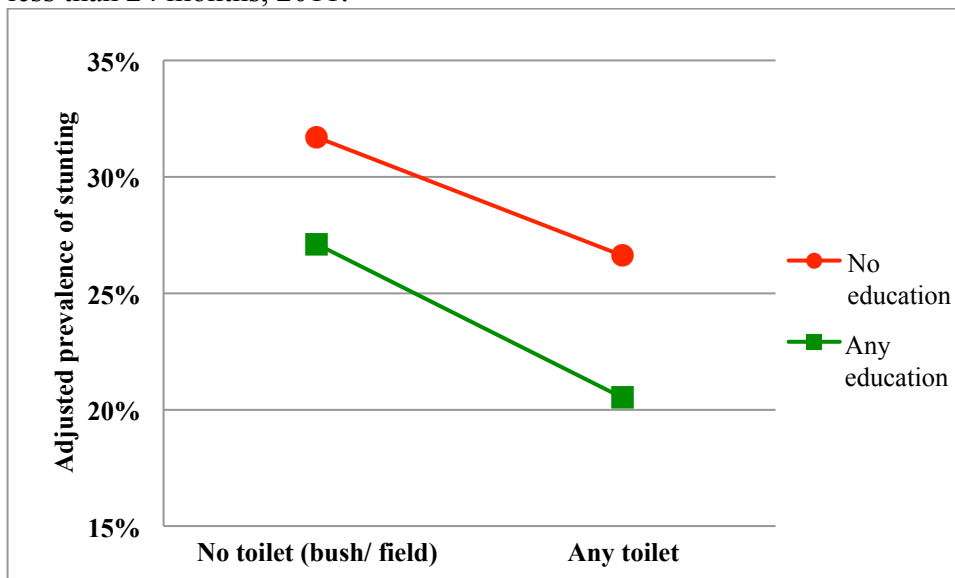


Mgood=1, un-weighted. See table 2.43 for data points.

Mean adjusted for: child's age in months, child's gender, poor water source, poor roof, and mother's height.

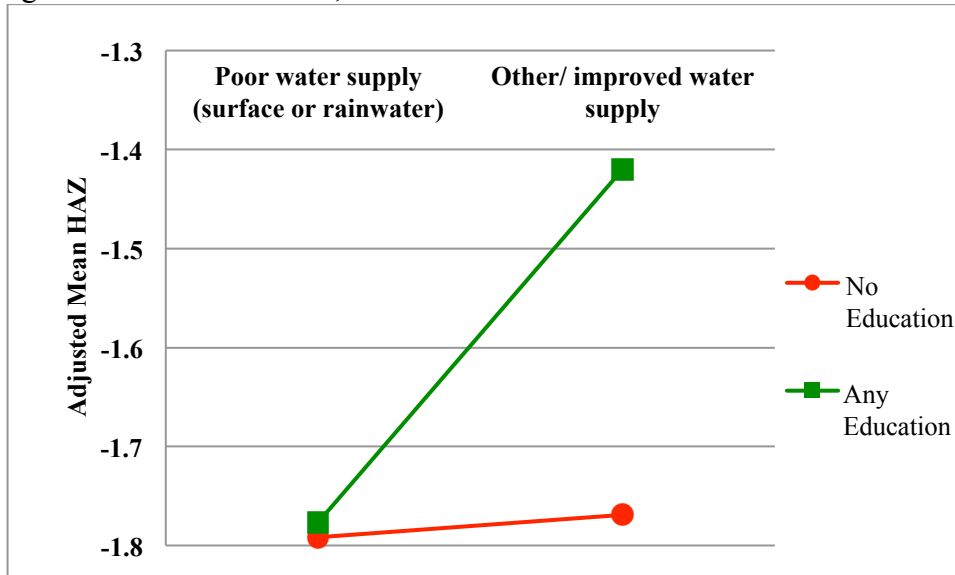
Note: Adjusted mean HAZ is significantly different between educated and un-educated among those with a toilet facility. Adjusted mean HAZ is also significantly different between those with and without a toilet facility among the educated, but this difference is not significant among the uneducated.

Figure 2.43 Interaction: Adjusted prevalence of stunting by toilet and education, ages less than 24 months, 2011.



Mgood=1, un-weighted. See table 2.44 for data points.

Figure 2.44 Interaction: Adjusted mean height-for-age by water source and education, ages 24 months and older, 2011.

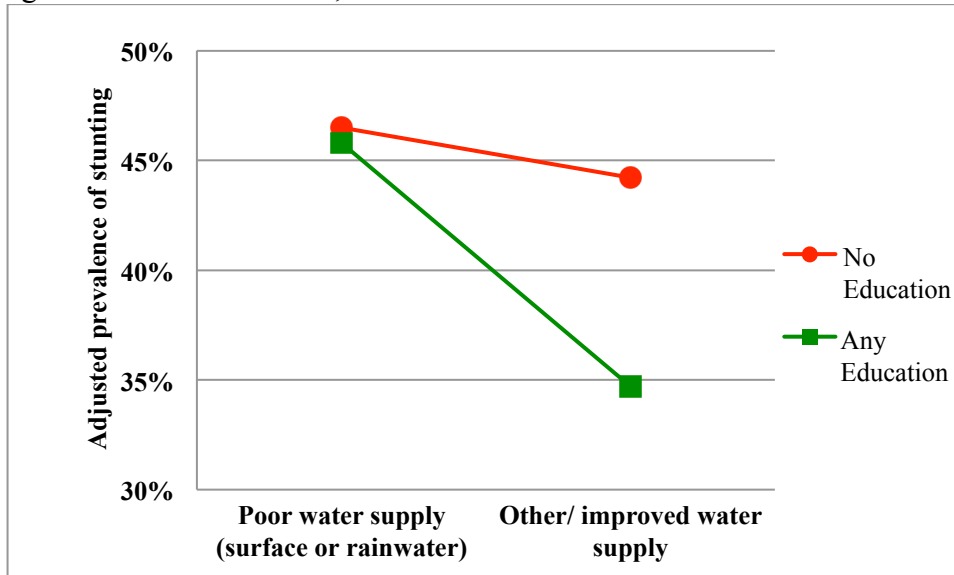


Mgood=1, 2011, un-weighted. See table 2.20 for data points.

Note:

- Mean adjusted for: child's age in months=43.48, child's gender=1.47, no toilet=0.51, poor roof=0.50, and mother's height in cm=157.6569.
- The difference in mean HAZ is significant between those with and without a poor water source among the educated at $p=0.000$, while there is no difference among the uneducated. Among those with a better water supply, the educated have a significantly higher mean HAZ ($p=0.000$).

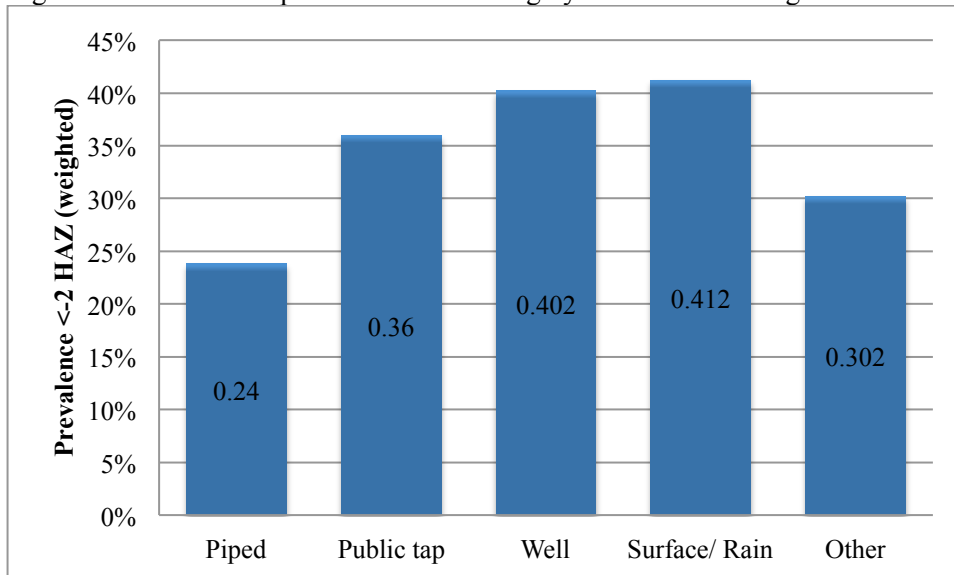
Figure 2.45 Interaction: Adjusted prevalence of stunting by water source and education ages 24 months and older, 2011.



Mgood=1, un-weighted. See table 2.20 for data points.

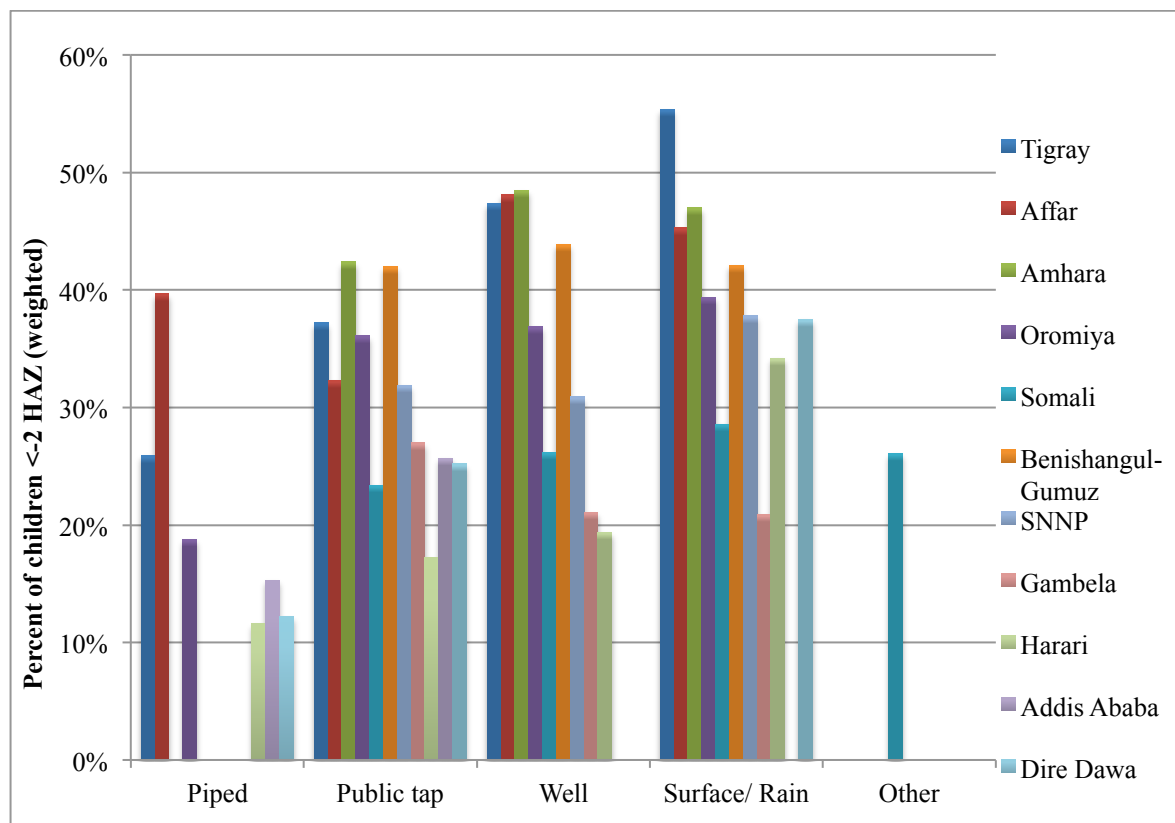
Note: Mean adjusted for: child's age in months=43.48, child's gender=1.47, no toilet=0.51, poor roof=0.50, and mother's height in cm=157.6569.

Figure 2.46 National prevalence of stunting by source of drinking water in 2011.



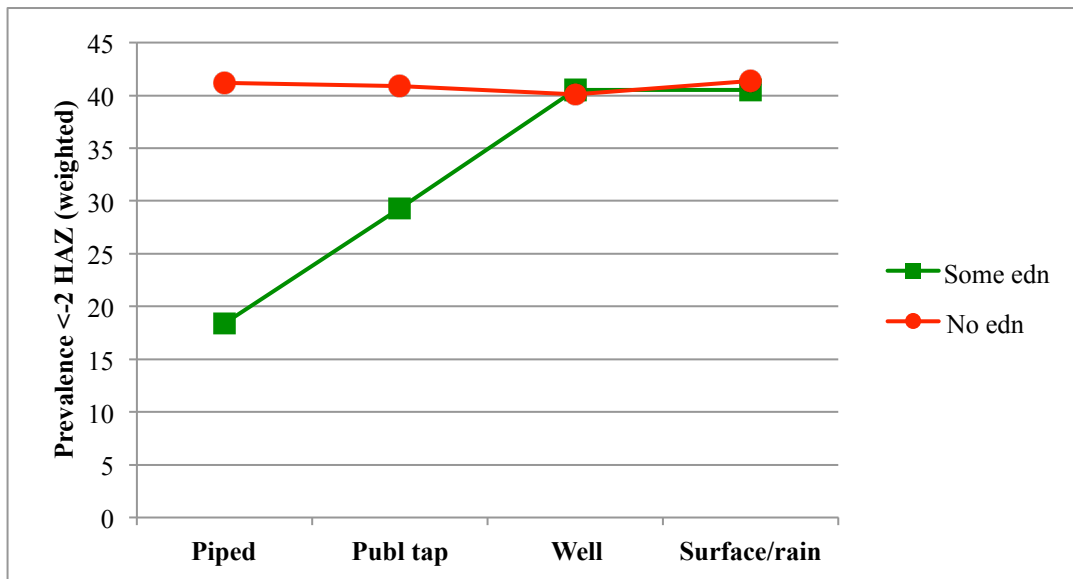
Mgood=1, weighted.

Figure 2.47 Regional prevalence of stunting by source of drinking water in 2011.



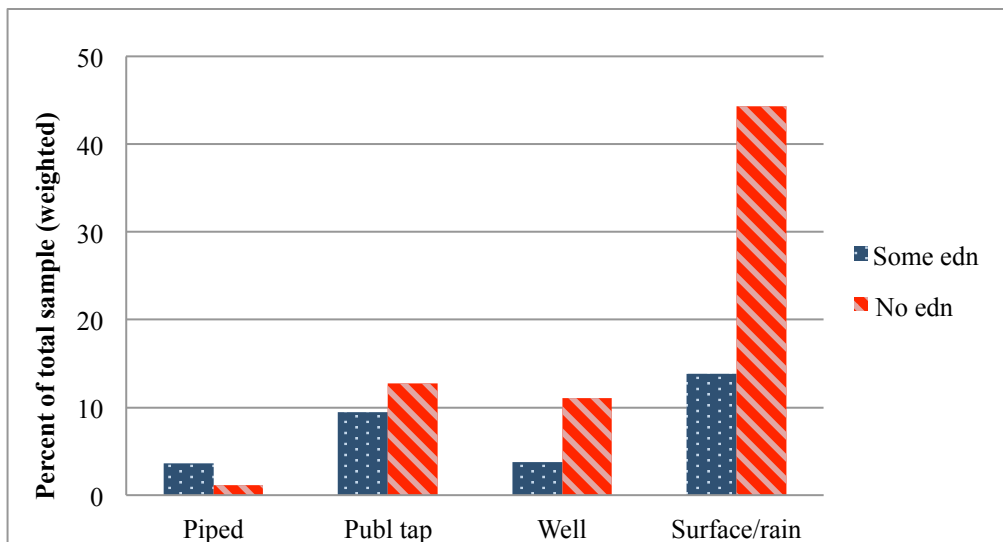
Mgood=1, weighted.

Figure 2.48 Stunting prevalence by education level and source of drinking water, all ages, 2011.



Mgood=1, weighted. See table 2.49 for data.

Figure 2.49 Percent of sample in each water source category by education level, all ages, 2011.



Mgood=1, weighted.

2.C Risk Factors: Poverty (assets) – Figures

Figure 2.50 Frequency distribution of height-for-age mean, for poorest two wealth quintiles, by survey (2000-2014).

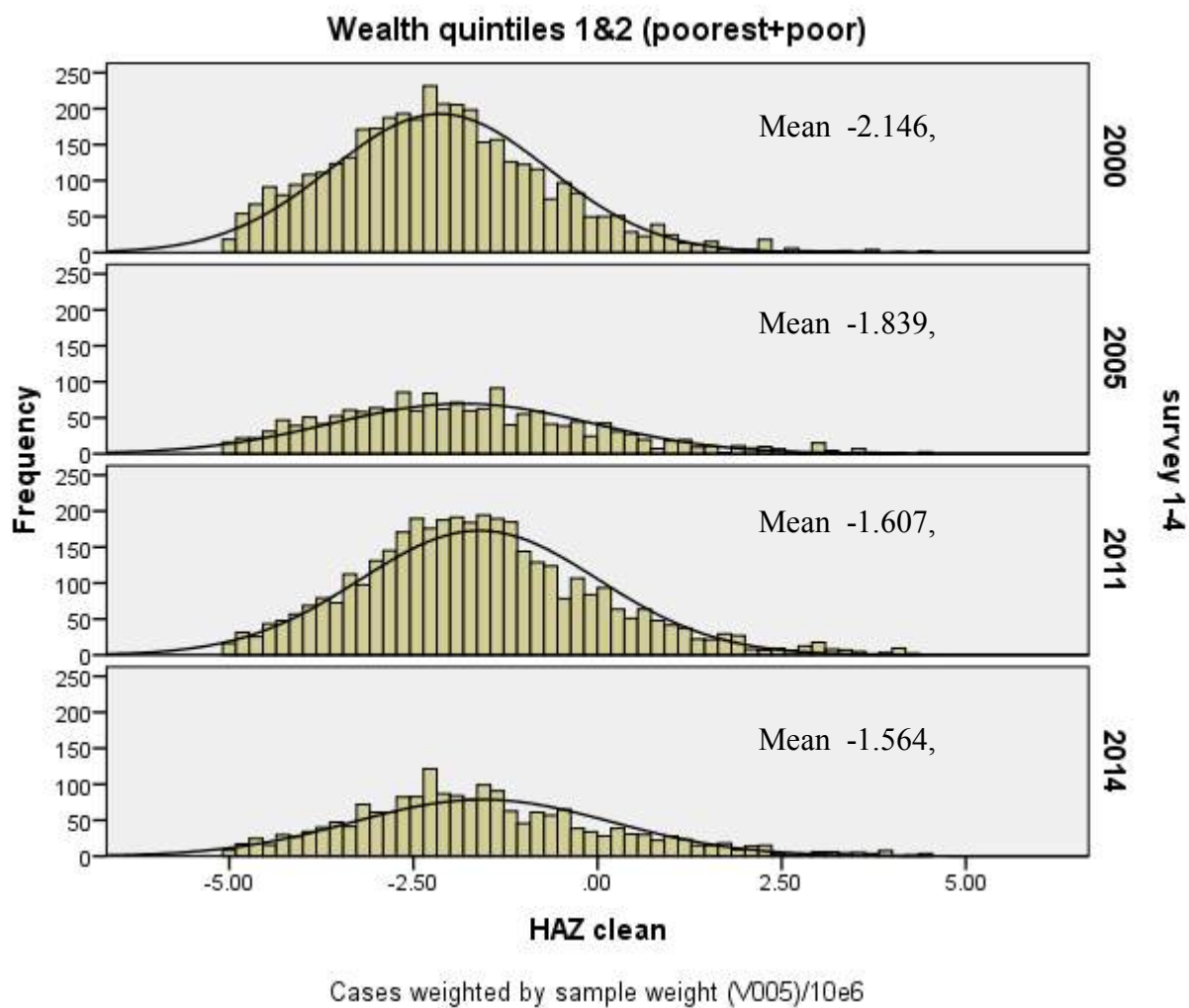


Figure 2.51 Frequency distribution of height-for-age mean, for all wealth quintiles, by survey (2000-2014).

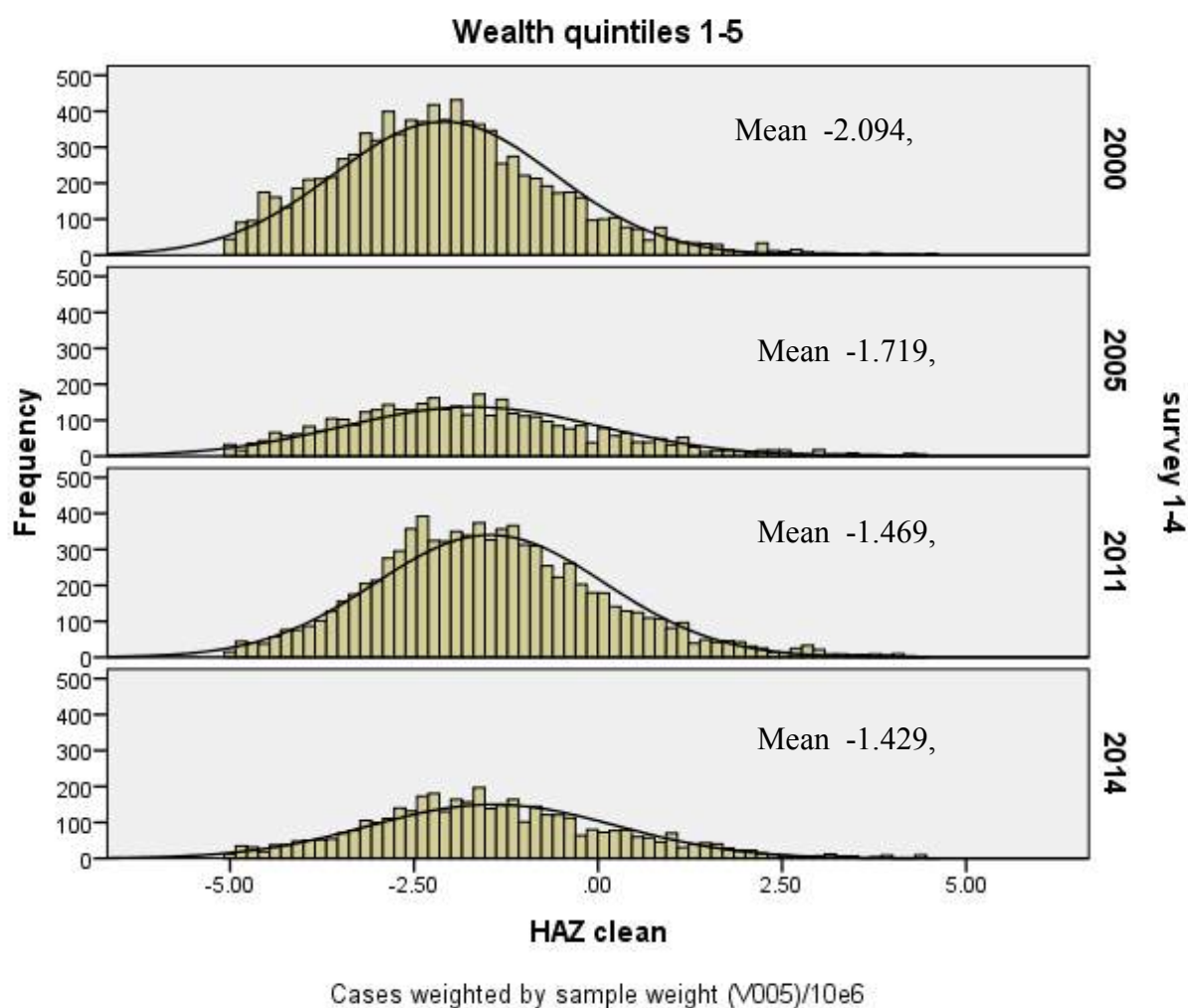


Figure 2.52 Frequency distribution of height-for-age mean, by wealth quintile, 2011.

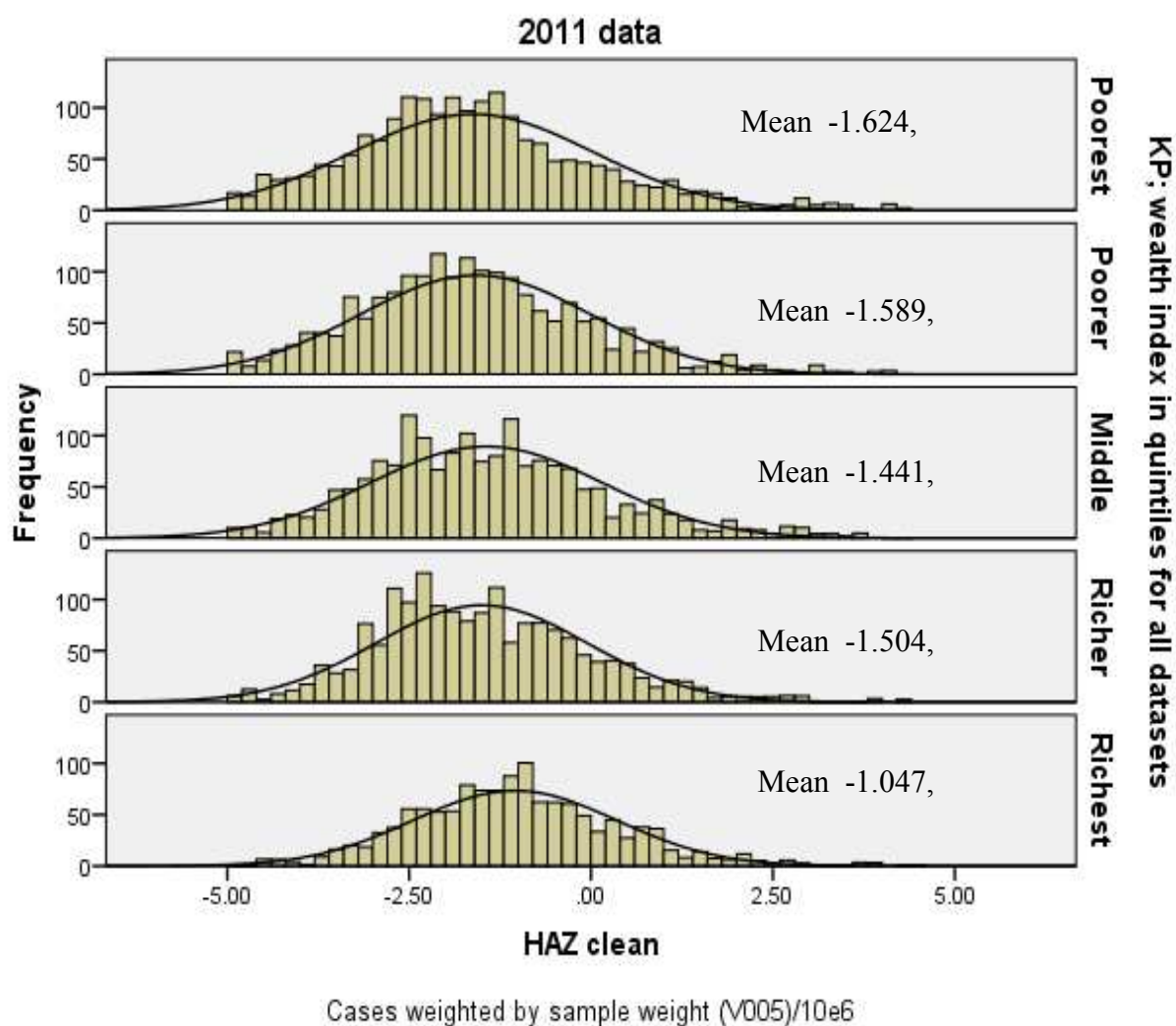


Figure 2.53 Frequency distribution of height-for-age mean, by wealth quintile, 2000.

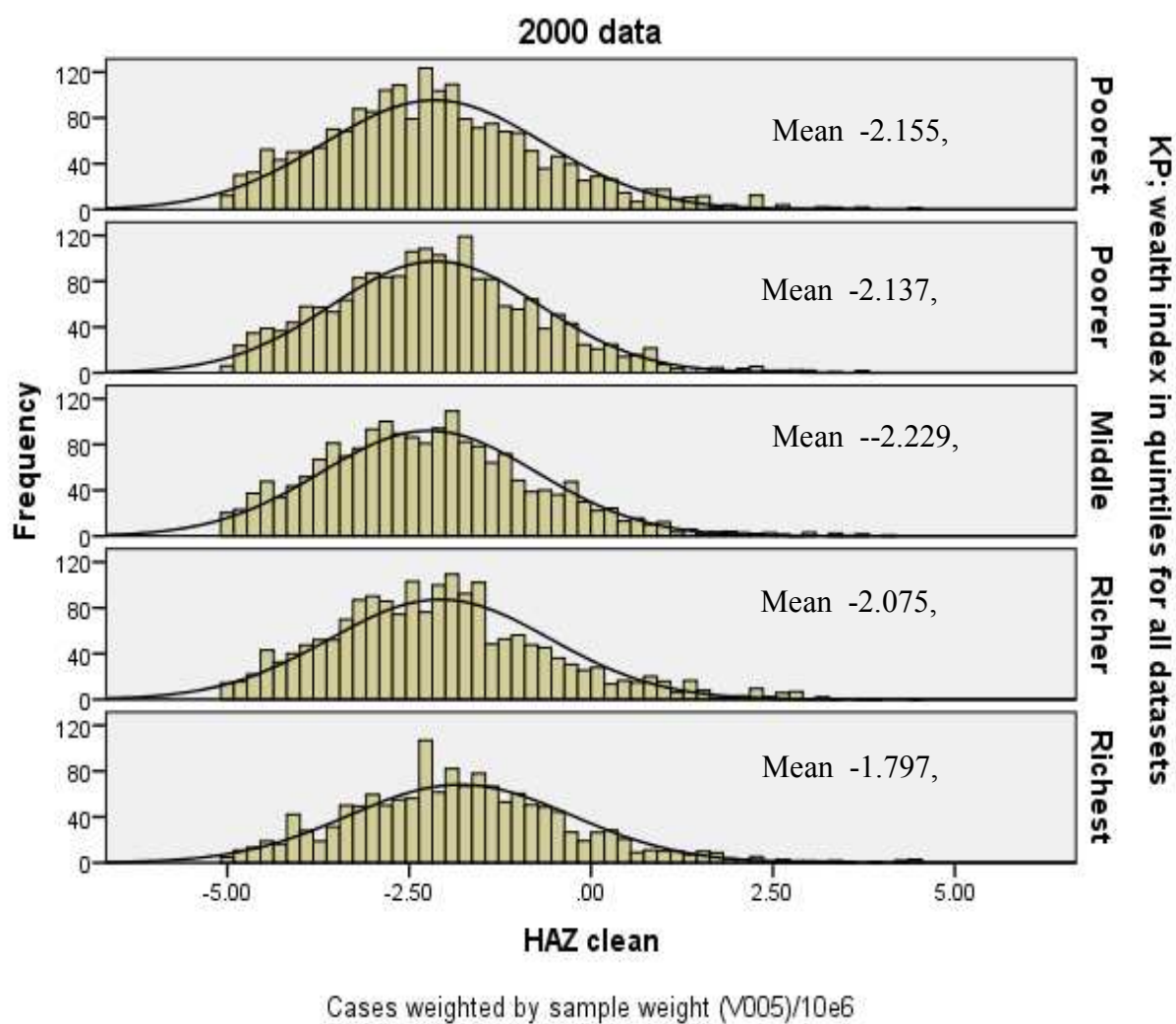
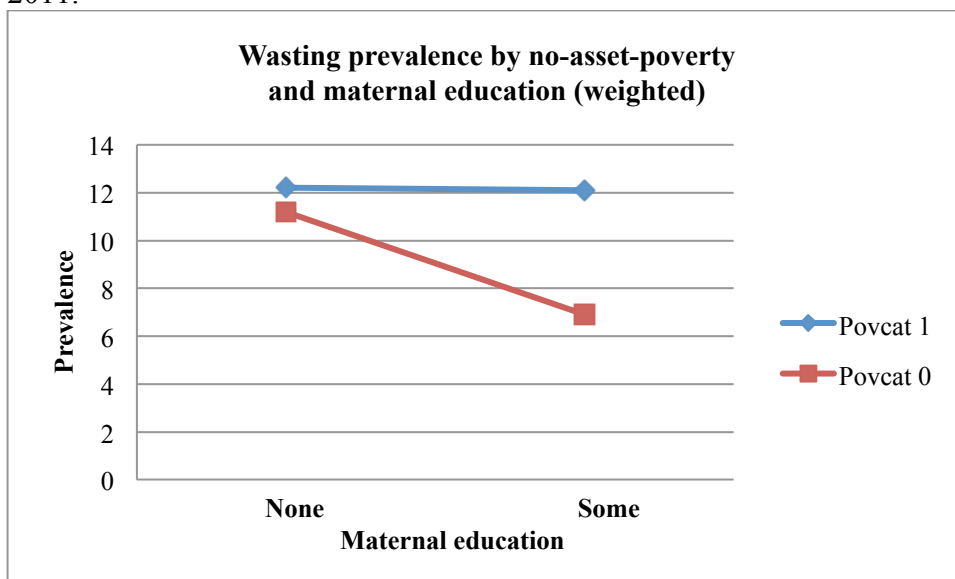
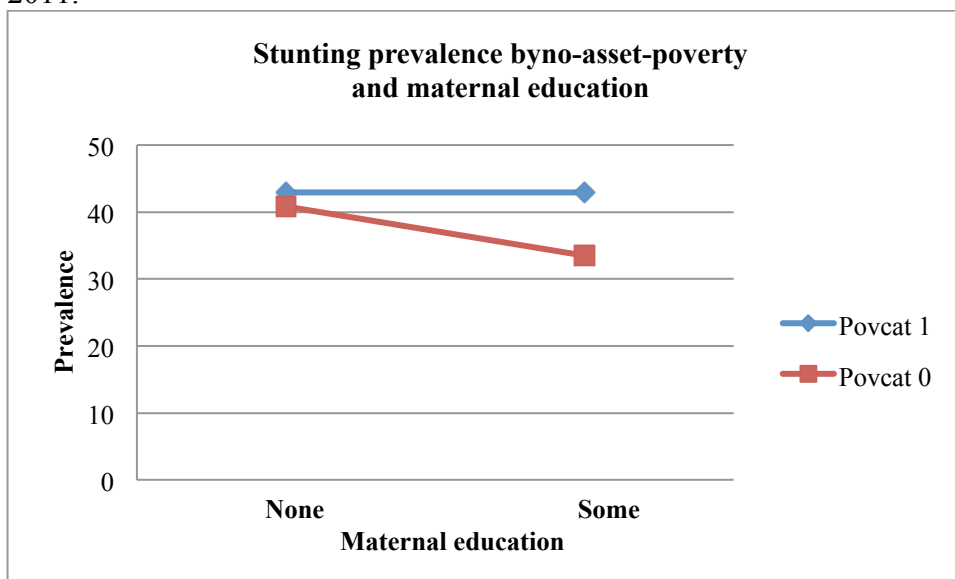


Figure 2.54 Wasting prevalence by no-asset-poverty and maternal education, all ages, 2011.



Interaction $p=0.019$, $n=8170$ (un-weighted)

Figure 2.55 Stunting prevalence by no-asset-poverty and maternal education, all ages, 2011.

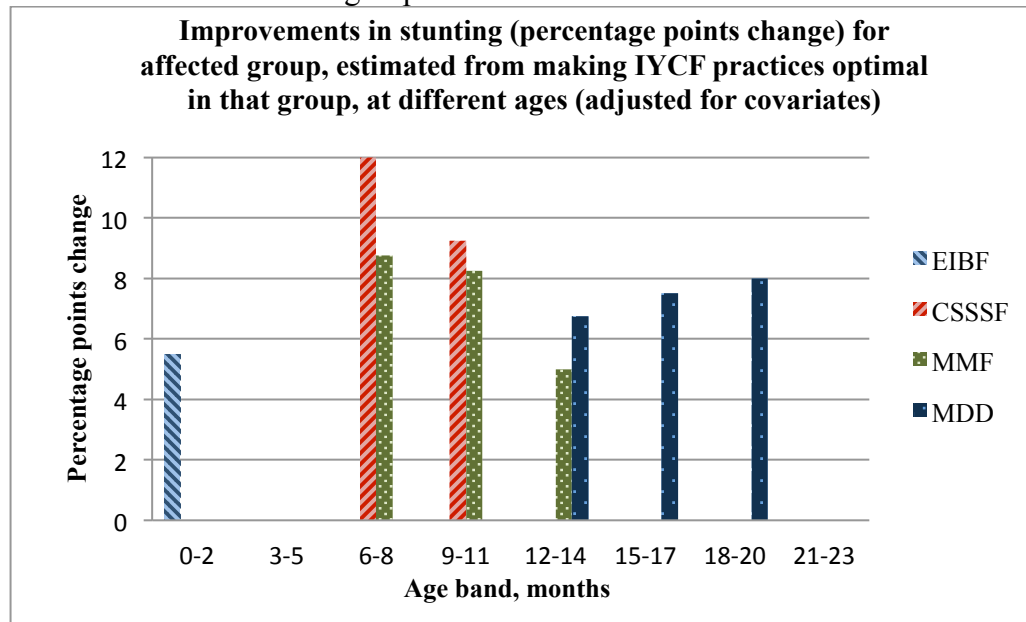


Interaction $p=0.113$, $n=8059$ (un-weighted; $p=0.001$ weighted, $n=8583$).

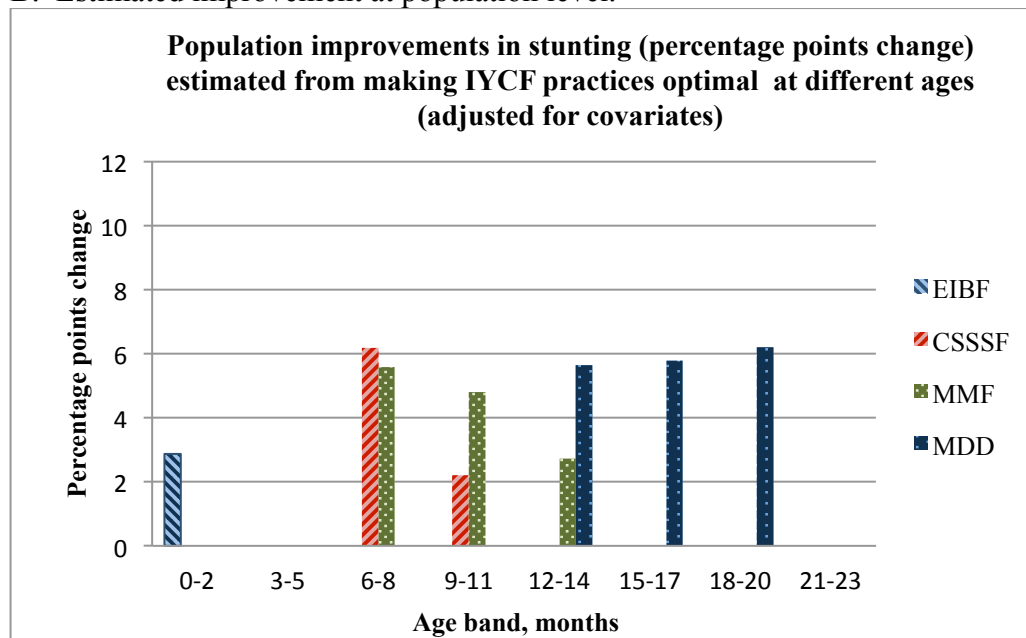
2.C Risk factors: IYCF – Figures

Figure 2.56 Effect of improving IYCF practices at different ages.

A. Effect size on affected group.



B. Estimated improvement at population level.



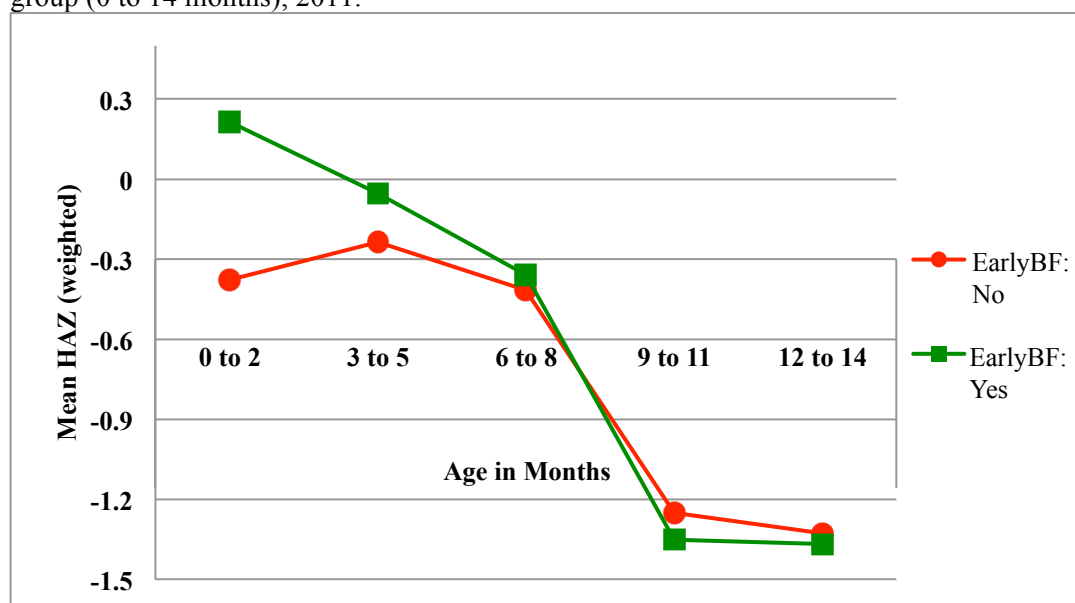
EIBF: Early initiation of breastfeeding

CSSSF: Consumption of solid, semi-solid or soft foods

MMF: minimum meal frequency

MDD: minimum dietary diversity (3 foods)

Figure 2.57 Mean height-for-age by early initiation of breastfeeding status and 3-month age group (0 to 14 months), 2011.



Mgood=1, weighted.

Note: HAZ differences between those who were and were not early initiated to breastfeeding are significant at $p=0.000$ in 0 to 2 month olds and non-significant thereafter (see table 2.50).

Figure 2.58 Adjusted mean height-for-age by early initiation of breastfeeding category and age.

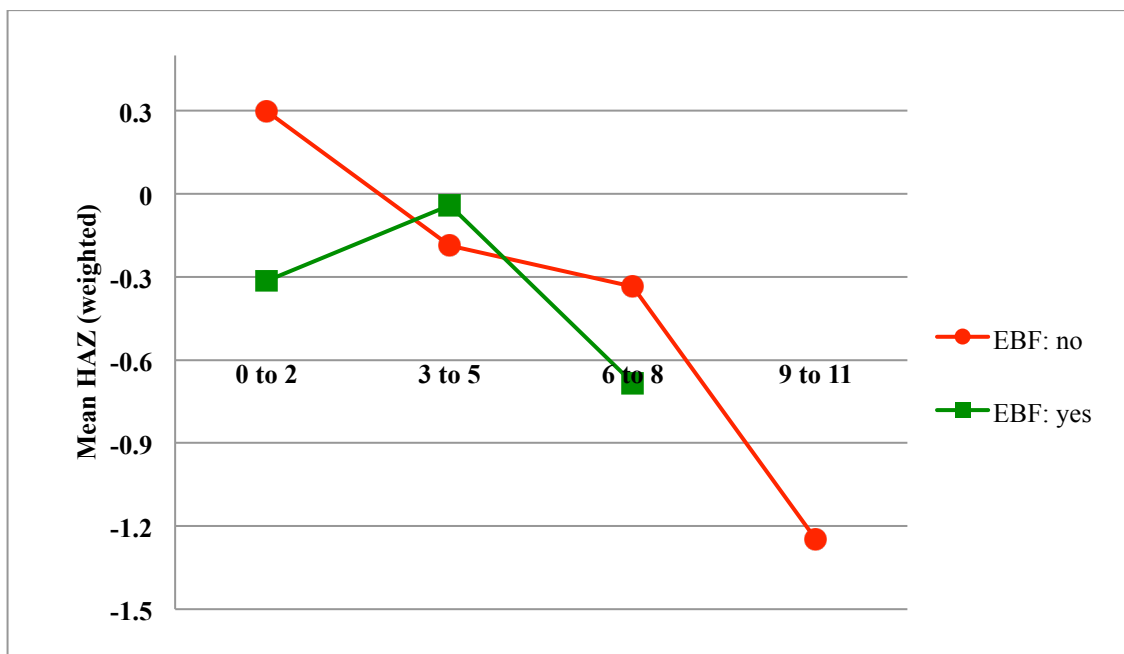


Mgood=1, un-weighted.

HAZ adjusted for gender, roofing, education and mother's height; see table 2.53.

Note: Adjusted HAZ differences between those who were and were not early initiated to breastfeeding are significant at $p \leq 0.05$ at 3 months, and at $p < 0.1$ at 1 and 5 months.

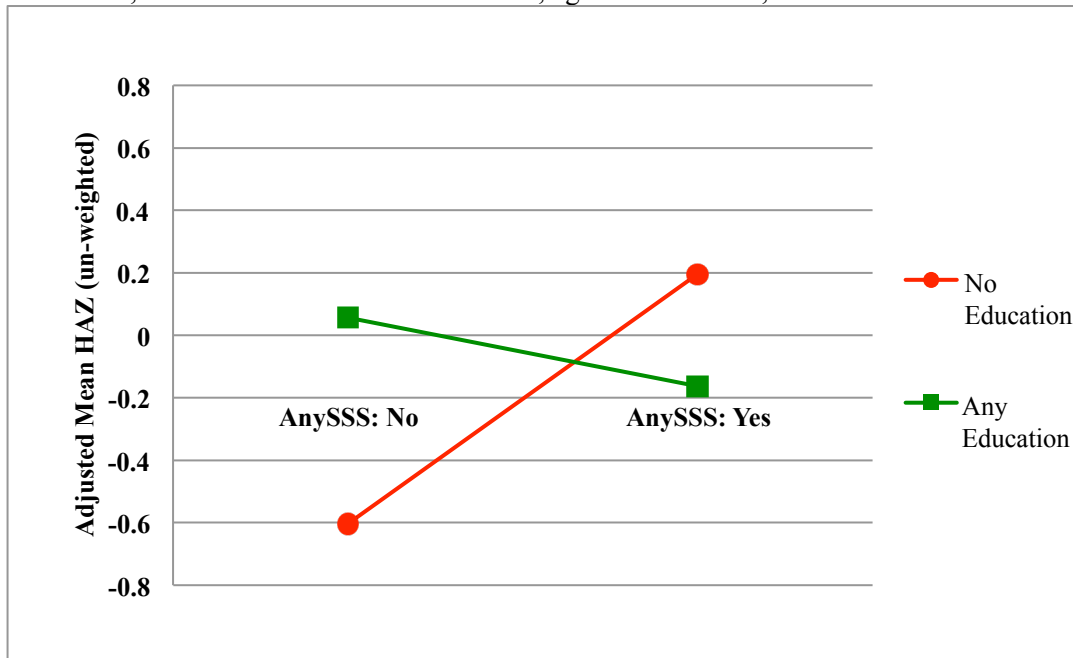
Figure 2.59 Height-for-age by exclusive breastfeeding status and 3-month age group (0 to 11 months) in 2011.



Mgood=1, weighted.

Note: at 0 to 2 months the difference in HAZ between EBF categories is significant at $p \leq 0.001$; the difference at other age groups is not statistically significant (see table 2.55).

Figure 2.60 Interaction: Adjusted mean height-for-age by category of consumption of any solid, semi-solid, or soft foods and education status, ages 6 to 8 month, 2011.

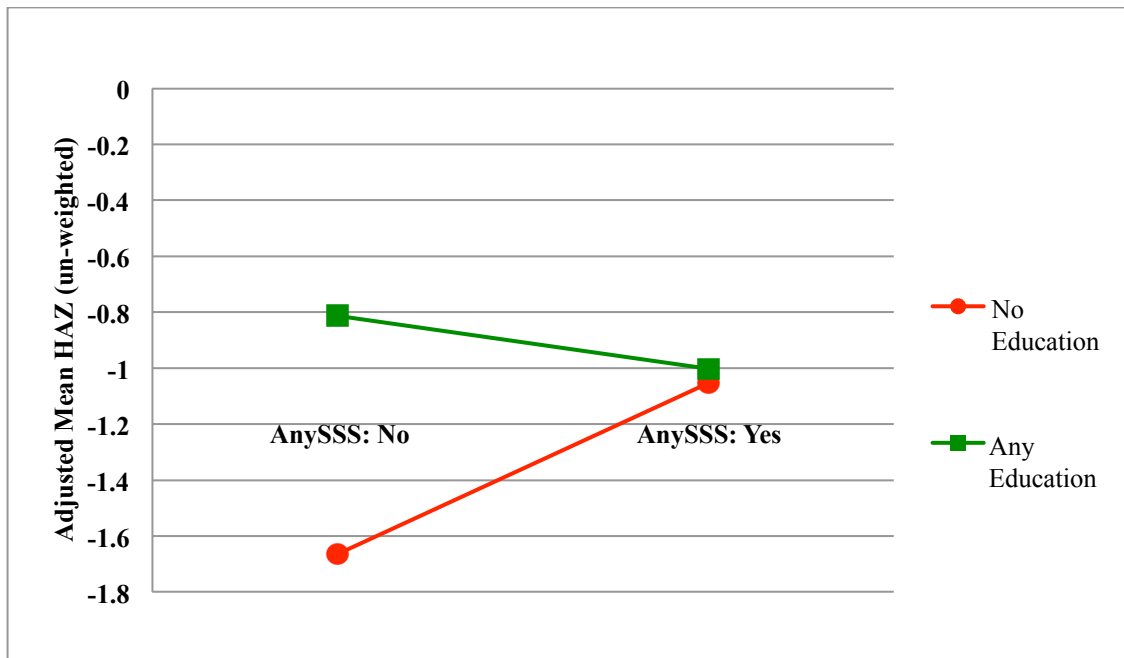


Mgood=1, un-weighted.

HAZ adjusted for age, gender, roofing, and mother's height.

Note: HAZ differences between those who are and are not receiving solid foods is significant at $p \leq 0.000$ among the uneducated (red line), but is not significant among the educated (green line).

Figure 2.61 Interaction: Adjusted mean height-for-age by category of consumption of any solid, semi-solid, or soft foods and education status, ages 9 to 11 month, 2011.

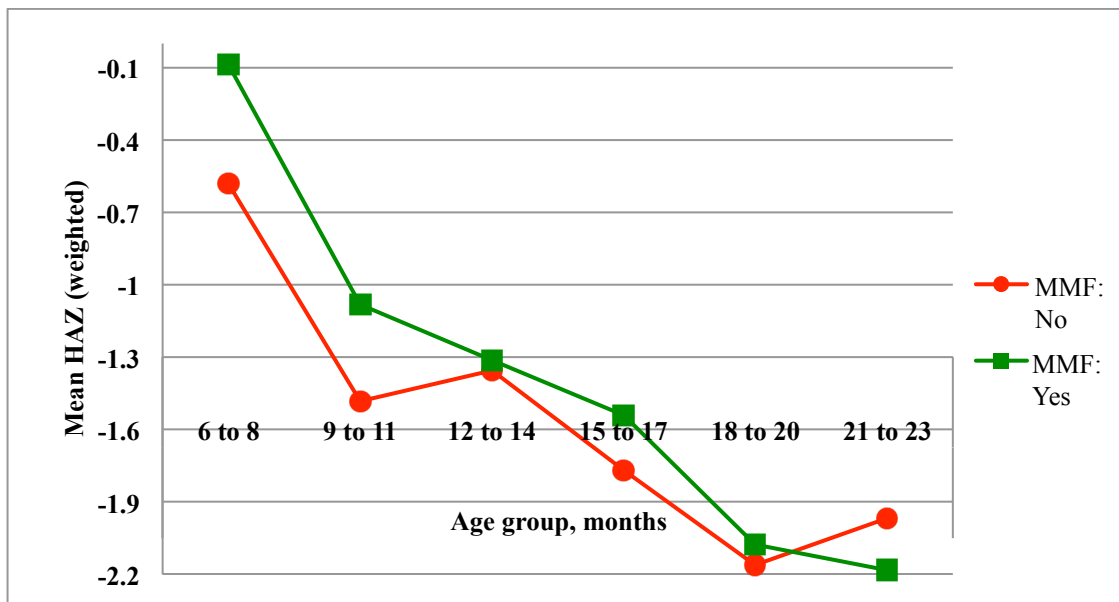


Mgood=1, un-weighted.

HAZ adjusted for age, gender, roofing, and mother's height; see table 2.64.

Note: HAZ differences between those who are and are not receiving solid foods is significant at $p \leq 0.001$ among the uneducated (red line), but is not significant among the educated (green line).

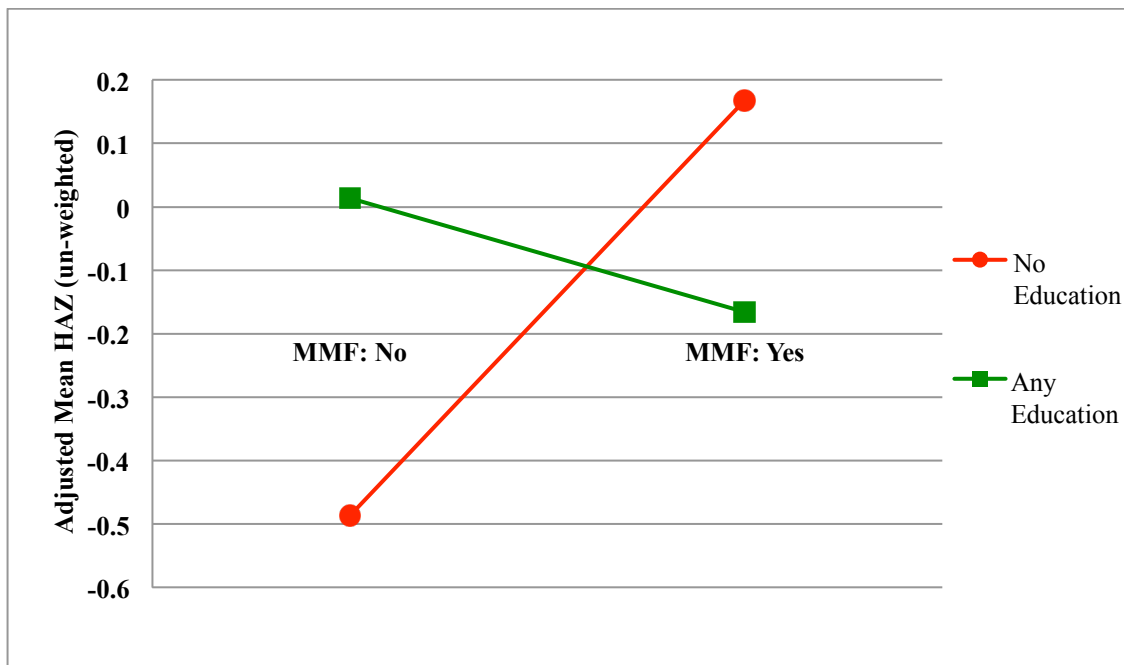
Figure 2.62 Mean height-for-age by minimum meal frequency status and 3-month age group (ages 6 to 23 months) in 2011.



Mgood=1, weighted.

Note: HAZ differences between those who are and are not receiving the minimum meal frequency is significant at $p \leq 0.000$ in the 6 to 8 months group and at $p \leq 0.01$ in the 9 to 11 months group (see table 2.66).

Figure 2.63 Interaction: Adjusted mean height-for-age by category of minimum meal frequency and education status in 6 to 8 month olds, 2011.



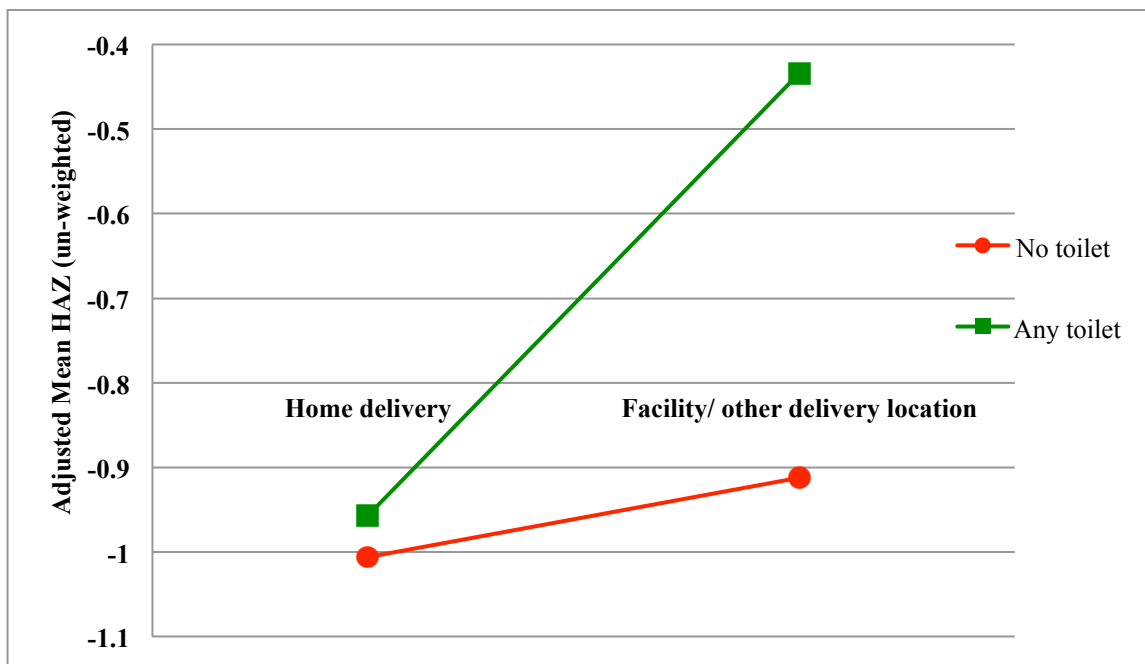
Mgood=1, un-weighted.

HAZ adjusted for age, gender, roofing, and mother's height; see table 2.67B.

Note: HAZ differences between those who are and are not receiving the minimum meal frequency is significant at $p \leq 0.05$ among the uneducated (red line), but is not significant among the educated (green line).

2.C Risk factors: Access to health services - Figures

Figure 2.64 Interaction: Adjusted mean height-for-age by delivery location and toilet type, ages less than 24 months, 2011.

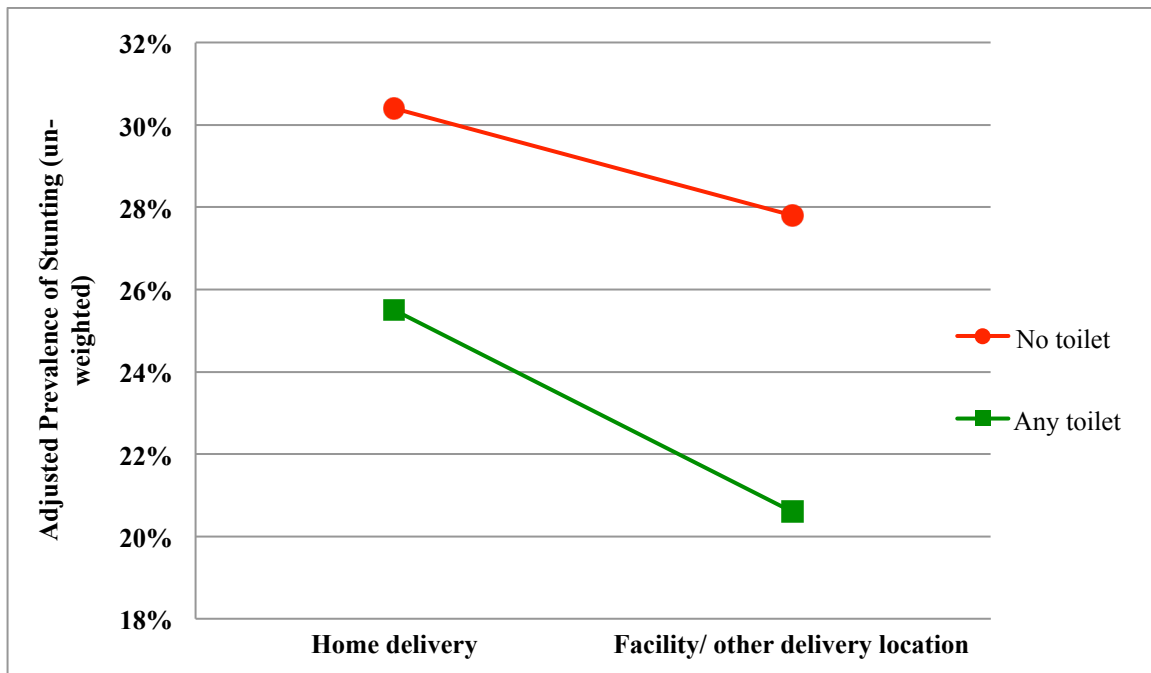


Mgood=1, un-weighted.

HAZ adjusted for age, gender, education, roofing, water source, and mother's height; see table 2.82.

Note: HAZ is significantly higher for those born in a health facility compared to those born at home among those with a toilet (green line), but not among those without a toilet (red line).

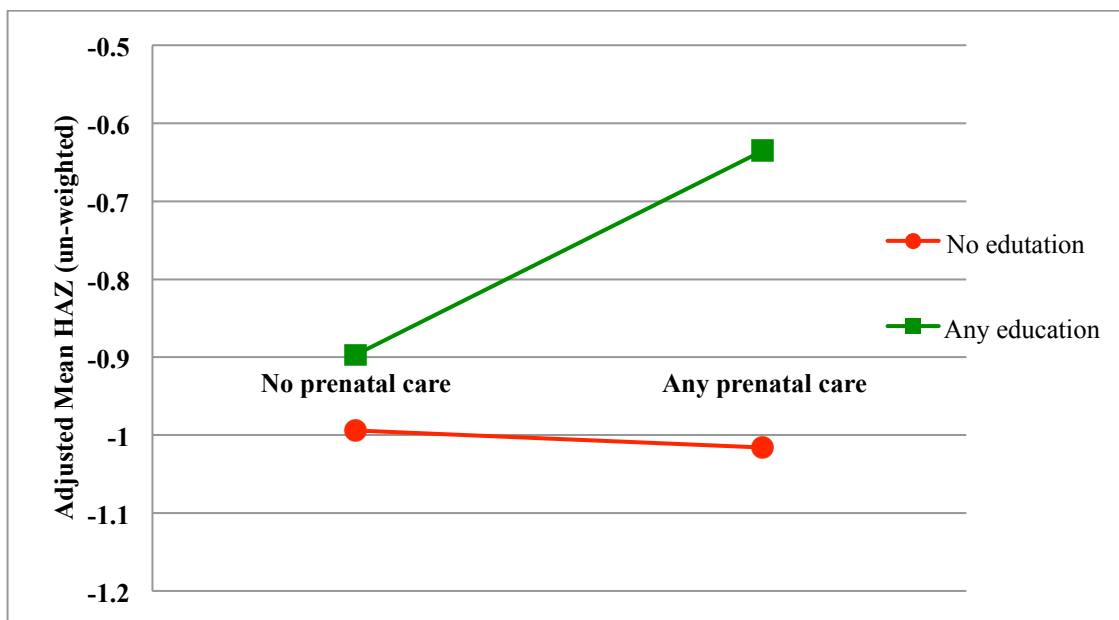
Figure 2.65 Interaction: Adjusted prevalence of stunting by delivery location and toilet type, ages less than 24 months, 2011.



Mgood=1, un-weighted.

Prevalence of stunting is adjusted for age, gender, education, roofing, water source, and mother's height; see table 2.82.

Figure 2.66 Interaction: Adjusted mean height-for-age by education level and antenatal care, ages less than 24 months, 2011.

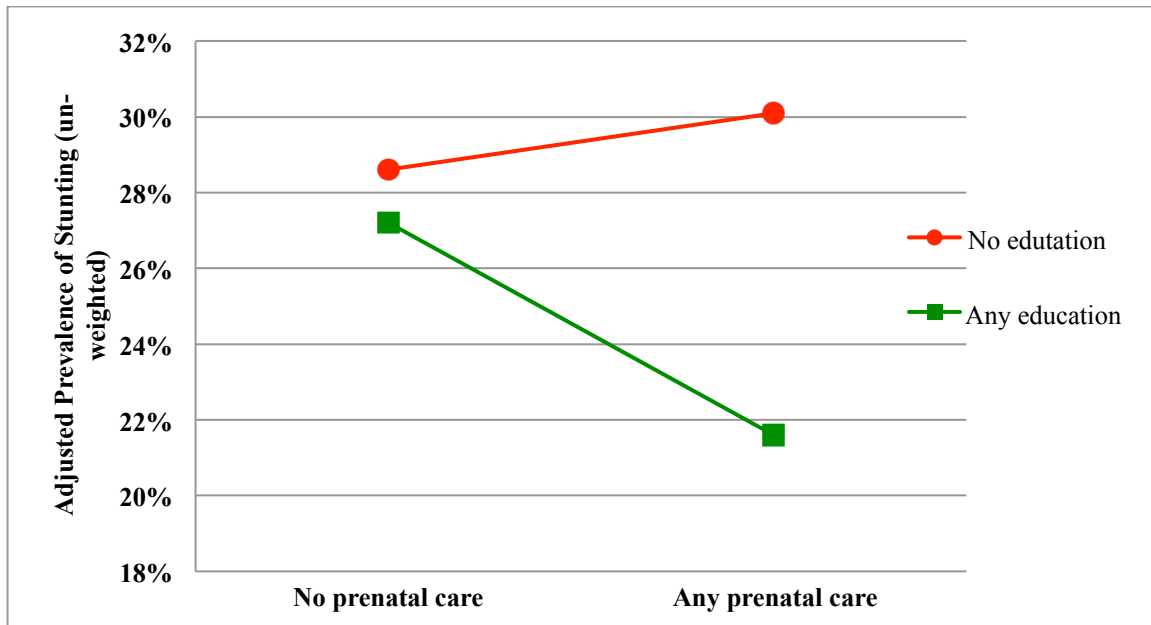


Mgood=1, un-weighted.

Mean HAZ is adjusted for age, gender, poor roofing, poor water source, no toilet, and mother's height; see table 2.90.

Note: the difference in HAZ between those with and without prenatal care is significant among the educated (green line) but is not significant among the uneducated (red line).

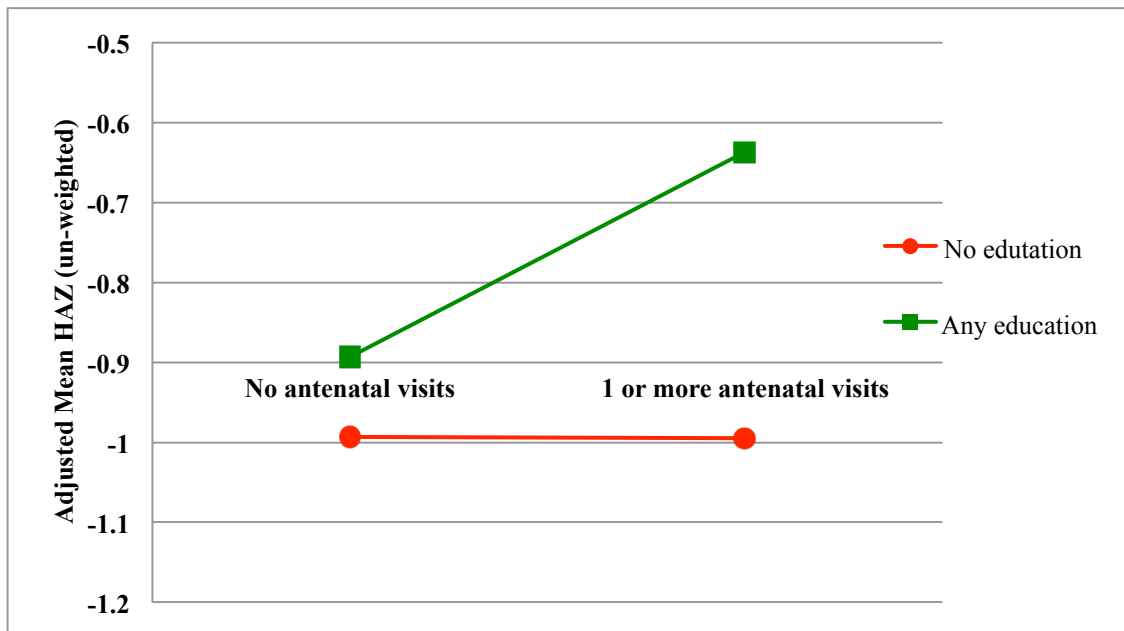
Figure 2.67 Interaction: Adjusted prevalence of stunting by education level and antenatal care, ages less than 24 months, 2011.



Mgood=1, un-weighted.

Prevalence is adjusted for age, gender, poor roofing, poor water source, no toilet, and mother's height; see table 2.90.

Figure 2.68 Interaction: Adjusted mean height-for-age by antenatal visits and education, ages less than 24 months, 2011.

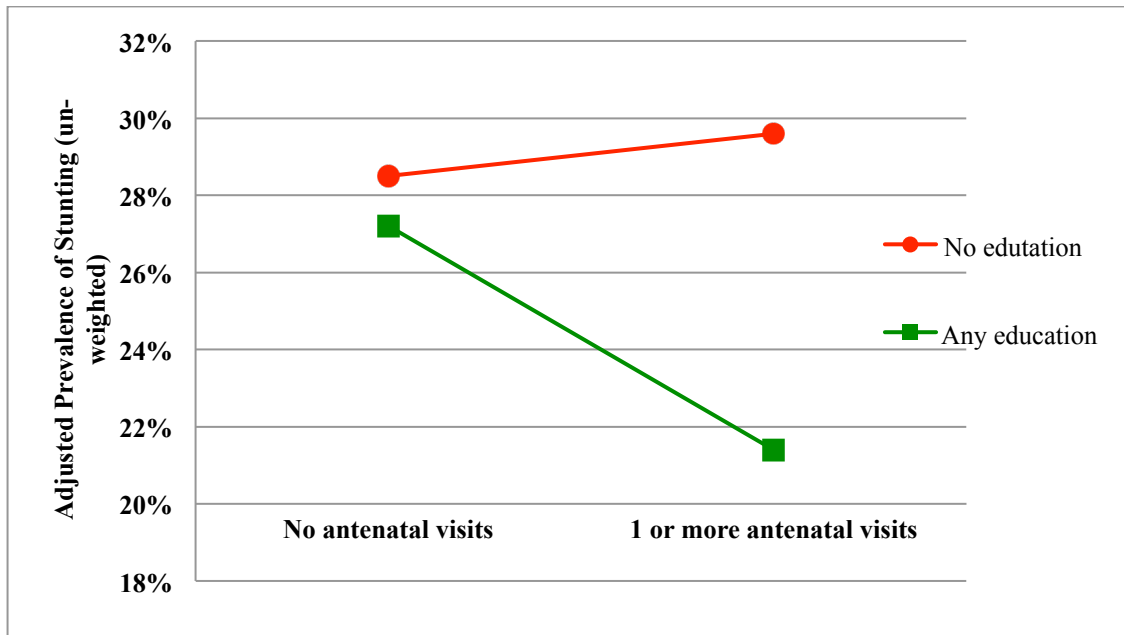


Mgood=1, un-weighted.

HAZ is adjusted for age in months, gender, poor roofing, poor water source, no toilet, mother's height, and interaction of antenatal visits and no education; see table 2.95.

Note: difference in HAZ is significant between those with 0 antenatal care visits versus those with one or more visits among the educated (green line) but not significant among the un-educated (red line).

Figure 2.69 Interaction: Adjusted prevalence of stunting by antenatal visits and education, ages less than 24 months, 2011.



Mgood=1, un-weighted.

Prevalence is adjusted for age in months, gender, poor roofing, poor water source, no toilet, mother's height, and interaction of antenatal visits and no education; see table 2.95.

2. Nutrition Situation Analysis for Guiding Decisions on Interventions

TABLES

2.A Methods – Tables

Table 2.1 A Description of independent variables.

Purpose of variable(s)	New variable names	Derivation variables and values of new variable	Notes, missing, etc.
Section 1: Classifying / controlling variables			
Maternal education	D_NoEd	From V106, Values: 1=no education 0=any education (primary, secondary or higher)	No missing cases among all four surveys.
Roofing	Roof	From V129; Values: 1=poor roof (thatch/leaf/mud) 2=rudimentary roof (wood/mud, reed/bamboo, plastic sheet, cardboard) 3=finished roof (iron, cement, shingles) 4=other	“Not a de jure resident” converted to missing.
	D_PoorRoof	From Roof; Values: 1=poor roof 0=rudimentary or finished roof	“Other” converted to missing.
	D_PoorRoof2	From Roof; Values: 1=poor roof 0=rudimentary, finished, or other roof	“Other” retained in 0 category, i.e. not a poor roof.
Floor	Floor	From V127; Values: 1=poor floor (earth/sand, dung) 2=rudimentary floor (wood planks, reed/bamboo) 3=finished floor (polished wood, vinyl, cement, carpet) 4=other	“Not a de jure resident” converted to missing.
	D_PoorFloor	From Floor; Values: 1=poor floor 0=rudimentary or finished floor	“Other” converted to missing.
	D_PoorFloor2	From Floor; Values: 1=poor floor 0=rudimentary, finished, or other floor	“Other” retained in 0 category, i.e. not a poor floor.
Poverty	povcat	From D_PoorRoof2, D_SurfaceWat, and D_NoToilet; Values: 1=poor roof, surface water, and no	

		toilet (i.e. extreme poverty) 0=else	
Livelihood	Livelihood		
Wealth	WealthQ	From V190: wealth index in quintiles Combined from all 4 surveys (imported from household dataset if not included in child-level data). Survey 1: imported from wealth index dataset.	
	WealthF	From V191: wealth index factor score Combined from all 4 surveys (imported from household dataset if not included in child-level data). Survey 1: imported from wealth index dataset.	
	Dwealth1	From WealthQ; Values: 1=wealth quintile 1 (poorest) 0=else (wealth quintile's 2-5)	
	Dwealth12	From WealthQ; Values: 1=wealth quintile 1 and 2 0=else (wealth quintile's 3-5)	
	Dwealth1234	From WealthQ; Values: 1=wealth quintile 1 through 4 0=else (wealth quintile 5)	
Age Groups	Age_grp	From HW1: Age in 3 month groups; Values: 1=0 to 2 months 2=3 to 5 months 3=6 to 8 months 9= 24+ months	
	Age_grp2	From HW1: Age in 2 month groups; Values: 0=0 to 1 months 1=2 to 3 months 2=4 to 5 months 12= 24+ months	
	Age_grp6	From HW1: Age in 6 month groups; Values: 1=0 to 5 months 2=6 to 11 months 3=12 to 17 months 6= 36+ months	
	Age_grp12	From HW1: Age groups in years; Values: 1=0 to 11 months 2=12 to 23 months	

		3=24 to 35 months 4=36 to 47 months 5=48 to 59 months	
Section 2: Water & Sanitation			
Water	Water	From V113; Values: 1=piped 2=public tap/piped outside compound 3=well 4=surface and rainwater 5=other	“Not a de jure resident” converted to missing.
	D_SurfaceWat	From Water; Values: 1=surface and rainwater 0=all other water sources	“Other” included in 0 category (all other water sources).
Toilet	Toilet	From V116; Values: 1=flush 2=improved pit 3=open pit 4=no toilet 5=other	“Not a de jure resident” converted to missing
	D_NoToilet	From Toilet; Values: 1=no toilet 0=any other toilet type	“Other” included in 0 category (any other toilet type).
Section 3: IYCF			
Early initiation of breastfeeding	EarlyBF	From V426; Values: 1=immediately/within 1 hour of birth 0=else	Missing for survey 4.
Exclusive breastfeeding	EBF	From AnyLiq, AnySSS, and BFnow; Values: 1=exclusively breastfeeding 0=not exclusively breastfeeding	Missing for survey 4. If missing for any of the determining variables (i.e. AnyLiq, AnySSS, or BFnow), then missing for EBF.
Currently breastfeeding	BF05	From V404 for 2005; Values: 1=currently breastfeeding 0=not currently breastfeeding	This is for survey 2 (2005) only.
	BF11	From V404 for 2011; Values: 1=currently breastfeeding 0=not currently breastfeeding	This is for survey 3 (2011) only.
	BFnow	From v404 (2000), BF05 (2005), and BF11 (2011); Values: 1=currently breastfeeding 0=not currently breastfeeding	Missing for survey 4.
Breastfeeding status	BFstat	From BFnow and EBF; Values: 0=non-breastfeeding 1=exclusively breastfeeding 2=non-exclusively breastfeeding	Missing for survey 4.
Liquids Consumed	Wat	From V409, survey 3; Values: 1=child drank water in last 24 hours 0=else	Don’t know recoded as missing.

Wat1	From v469a, survey 1; Values: 1=child drank water in last 24 hours 0=else	Don't know recoded as missing.
Wat2	From V469A, survey 2; Values: 1=child drank water in last 24 hours 0=else	Don't know recoded as missing.
Juice	From V410, survey 3; Values: 1=child drank juice in last 24 hours 0=else	Don't know recoded as missing.
Juice1	From v469c, survey 1; Values: 1=child drank water in last 24 hours 0=else	Don't know recoded as missing.
Juice2	From V469D, survey 2; Values: 1=child drank water in last 24 hours 0=else	Don't know recoded as missing.
Milk	From V411, survey 3; Values: 1=child drank milk in last 24 hours 0=else	Don't know recoded as missing.
Milk1	From v469h, survey 1; Values: 1=child drank milk in last 24 hours 0=else	Don't know recoded as missing.
Milk2	From V469C, survey 2; Values: 1=child drank milk in last 24 hours 0=else	Don't know recoded as missing.
Formula	From V411A, survey3; Values: 1=child drank formula in last 24 hours 0=else	Don't know recoded as missing.
BabFood2	From V469B, survey 2 (infant formula); Values: 1=child drank formula in last 24 hours 0=else	Don't know recoded as missing.
Soup	From V412C, survey 3; Values: 1=child had soup in last 24 hours 0=else	Don't know recoded as missing.
Tea2	From V469E, survey 2; Values: 1=child drank tea in last 24 hours 0=else	Don't know recoded as missing.
OthLiq	From V413, survey 3; Values: 1=child drank other liquids in last 24 hours 0=else	Don't know recoded as missing.
OthLiq1	From v469l, survey 1; Values: 1=child drank other liquids in last 24 hours 0=else	Don't know recoded as missing.
OthLiq2	From S469A, survey 2; Values:	Don't know recoded as missing.

		1=child drank other liquids in last 24 hours 0=else	
	AnyLiq	From all liquid variables above (Wat through OthLiq2); Values: 1=child drank any liquids other than breastmilk yesterday (including water) 0=else	
Grains	Grain1	From v469q, survey 1; Values: 1=child had grains in last 24 hours 0=else	Don't know recoded as missing.
	Bread2	From S470C, survey 2; Values: 1=child had bread in last 24 hours 0=else	Don't know recoded as missing.
	Porridge	From S470A, survey 2; Values: 1=child had porridge in last 24 hours 0=else	
	Teff2	From S470D, survey 2; Values: 1=child had teff in last 24 hours 0=else	Don't know recoded as missing.
	BabFood2b	From V470B, survey 2 (commercially fortified babyfood) ; Values: 1=child had baby food in last 24 hours 0=else	Don't know recoded as missing.
	BabFood	From V412A, survey 3 (fortified baby food – cerelac, etc.) ; Values: 1=child had baby food in last 24 hours 0=else	Don't know recoded as missing.
	Grain	From V414E, survey 3; Values: 1=child had grains in last 24 hours 0=else	Don't know recoded as missing.
Tubers	Tubers1	From v469r, survey 1; Values: 1=child had tubers in last 24 hours 0=else	Don't know recoded as missing.
	Potatoes2	From S470E, survey 2; Values: 1=child had potatoes in last 24 hours 0=else	Don't know recoded as missing.
	Tubers	From V414F, survey 3; Values: 1=child had tubers in last 24 hours 0=else	Don't know recoded as missing.
Eggs	Eggs2	From S470M, survey 2; Values: 1=child had eggs in last 24 hours 0=else	Don't know recoded as missing.
	Eggs	From V414G, survey 3; Values: 1=child had eggs in last 24 hours	Don't know recoded as missing.

		0=else	
Meats	MeatEggs1	From v469v, survey 1; Values: 1=child had meats or eggs in last 24 hours 0=else	Don't know recoded as missing.
	Meat2	From S470K, survey 2; Values: 1=child had meats in last 24 hours 0=else	Don't know recoded as missing.
	Organ2	From S470J, survey 2; Values: 1=child had organ meats in last 24 hours 0=else	Don't know recoded as missing.
	Poultry2	From S470L, survey 2; Values: 1=child had poultry in last 24 hours 0=else	Don't know recoded as missing.
	Fish2	From S470N, survey 2; Values: 1=child had fish in last 24 hours 0=else	Don't know recoded as missing.
	Meat	From V414H, survey 3; Values: 1=child had meats in last 24 hours 0=else	Don't know recoded as missing.
	Organs	From V414M, survey 3; Values: 1=child had organ meats in last 24 hours 0=else	Don't know recoded as missing.
	Fish	From V414N, survey 3; Values: 1=child had fish in last 24 hours 0=else	Don't know recoded as missing.
Vitamin A rich foods	Arich1	From v469o, survey 1; Values: 1=child had vitamin A rich fruits in last 24 hours 0=else	Don't know recoded as missing.
	Orange2	From S470F, survey 2; Values: 1=child had orange vegetables in last 24 hours 0=else	Don't know recoded as missing.
	Green2	From S470G, survey 2; Values: 1=child had green vegetables in last 24 hours 0=else	Don't know recoded as missing.
	AFruits2	From S470H, survey 2; Values: 1=child had vitamin A rich fruits in last 24 hours 0=else	Don't know recoded as missing.
	Orange	From V414I, survey 3; Values: 1=child had orange vegetables in last 24 hours 0=else	Don't know recoded as missing.

	Green	From V414J, survey 3; Values: 1=child had green vegetables in last 24 hours 0=else	Don't know recoded as missing.
	AFruits	From V414K, survey 3; Values: 1=child had vitamin A rich fruits in last 24 hours 0=else	Don't know recoded as missing.
Legumes	Legumes1	From v469w, survey 1; Values: 1=child had legumes in last 24 hours 0=else	Don't know recoded as missing.
	Beans2	From S470O, survey 2; Values: 1=child had beans in last 24 hours 0=else	Don't know recoded as missing.
	Nuts2	From S470P, survey 2; Values: 1=child had nuts in last 24 hours 0=else	Don't know recoded as missing.
	Legumes	From V414O, survey 3; Values: 1=child had legumes in last 24 hours 0=else	Don't know recoded as missing.
Other fruits and vegetables	OthFV1	From v469u, survey 1; Values: 1=child had other fruits or vegetables in last 24 hours 0=else	Don't know recoded as missing.
	OthFV2	From S470I, survey 2; Values: 1=child had other fruits or vegetables in last 24 hours 0=else	Don't know recoded as missing.
	OthFruit	From V414L, survey 3; Values: 1=child had other fruits in last 24 hours 0=else	Don't know recoded as missing.
Dairy	Dairy2	From S470Q, survey 2; Values: 1=child had dairy in last 24 hours 0=else	Don't know recoded as missing.
	Dairy	From V414P, survey 3; Values: 1=child had dairy in last 24 hours 0=else	Don't know recoded as missing.
	Yog	From V414V, survey 3; Values: 1=child had yogurt in last 24 hours 0=else	Don't know recoded as missing.
Fats	Fats1	From v469y, survey 1; Values: 1=child had fats in last 24 hours 0=else	Don't know recoded as missing.
	Fats2	From S470R, survey 2; Values: 1=child had fats in last 24 hours 0=else	Don't know recoded as missing.
Other solid,	OthSSS2	From S470S, survey 2; Values:	Don't know recoded as missing.

semi-solid, or soft foods		1=child had any other foods in last 24 hours 0=else	
	OthSSS	From V414S, survey 3; Values: 1=child had any other foods in last 24 hours 0=else	Don't know recoded as missing.
Any solid, semi-solid, or soft foods.	AnySSS	From all solid, semi-solid or soft food variables above (Grain1 through OthSSS); Values: 1=child ate any solid, semi-solid or soft foods yesterday 0=else	
Food 1 (Grains)	Food1_1	From Grain1 and Tubers1; Values: 1=child ate grains, roots, or tubers 0=else	Survey 1 only.
	Food2_1	From Porridge2, BabFood2b, Bread2, Teff2, and Potatoes2; Values: 1=child ate porridge, baby food, bread, teff, potatoes, other grains 0=else	Survey 2 only.
	Food3_1	From Grain, Tubers and BabFood; Values: 1=child ate grains, tubers, baby food 0=else	Survey 3 only.
Food 2 (Legumes)	Food1_2	From Legumes1; Values: 1=child ate legumes 0=else	Survey 1 only.
	Food2_2	From Beans2 and Nuts2; Values: 1=child ate beans or nuts 0=else	Survey 2 only.
	Food3_2	From Legumes; Values: 1=child ate legumes 0=else	Survey 3 only.
Food 3 (Dairy)	Food1_3	From Milk1; Values: 1=child drank milk 0=else	Survey 1 only.
	Food2_3	From Milk2 and Dairy2; Values: 1=child had milk or dairy 0=else	Survey 2 only.
	Food3_3	From Milk, Formula, and Dairy; Values: 1=child had milk, baby formula or dairy 0=else	Survey 3 only.
Food 4 (Meats, poultry, fish,	Food1_4	From MeatEggs1; Values: 1=child ate meat, poultry, fish, shellfish or eggs	Survey 1 only.

animal foods)		0=else	
	Food2_4	From Organ2, Meat2, Poultry2, and Fish2; Values: 1=child ate organ meats, meats, poultry, or fish 0=else	Survey 2 only.
	Food3_4	From Meat, Organs, and Fish; Values: 1=child ate organ meats, meat, poultry, or fish 0=else	Survey 3 only.
Food 5 (Eggs)	Food1_5	Missing “eggs” variable in survey 1	Survey 1 only. Missing.
	Food2_5	From Eggs2; Values: 1=child ate eggs 0=else	Survey 2 only.
	Food3_5	From Eggs; Values: 1=child ate eggs 0=else	Survey 3 only.
Food 6 (Vitamin A rich foods)	Food1_6	From Arich1; Values: 1=child ate vitamin A rich fruits 0=else	Survey 1 only.
	Food2_6	From Orange2, Green2, and AFruits2; Values: 1=child ate orange or green vegetables, or vitamin A rich fruits 0=else	Survey 2 only.
	Food3_6	From Orange, Green, and AFruits; Values: 1=child ate orange or green vegetables, or vitamin A rich fruits 0=else	Survey 3 only.
Food 7 (Other fruits and vegetables)	Food1_7	From OthFV1; Values: 1=child ate other fruits or vegetables 0=else	Survey 1 only.
	Food2_7	From OthFV2; Values: 1=child ate other fruits or vegetables 0=else	Survey 2 only.
	Food3_7	From OthFruit; Values: 1=child ate other fruits 0=else	Survey 3 only.
Food 8 (Meats and eggs together – survey 2 and 3 only)	Food2_8	From Food2_4 and Food2_5; Values: 1=child ate organ meats, meats, poultry, fish, or eggs 0=else	Survey 2 only.
	Food3_8	From Meat, Organs, Fish and Eggs; Values: 1=child ate organ meats, meats, poultry, fish, or eggs 0=else	Survey 3 only.

Total number of food groups consumed	Food_grps_tot1	From Food1_1 to Food1_7; Values: 0 through 6, summation of above variables; total number of food groups eaten. *Food1_5 is missing for survey 1; so possible values are 0 through 6.	Survey 1 only. Out of 6 total food groups. Survey 1 does not have a separate “eggs” category, so only 6 food groups are possible.
	Food_grps_tot2	From Food2_1 to Food2_7; Values: 0 through 7, summation of above variables; total number of food groups eaten.	Survey 2 only. Out of 7 total possible food groups.
	Food_grps_tot2b	From Food2_1 to Food2_3, and Food2_6 through Food2_8; Values: 0 through 6, summation of above variables; total number of food groups eaten.	Survey 2 only. Out of 6 total food groups; eggs have been combined with meats.
	Food_grps_tot3	From Food3_1 through Food3_7 Values: 0 through 7, summation of above variables; total number of food groups eaten.	Survey 3 only. Out of 7 total possible food groups.
	Food_grps_tot3b	From Food3_1 through Food3_3, and Food3_6 through Food3_8 Values: 0 through 6, summation of above variables; total number of food groups eaten.	Survey 3 only. Out of 6 total food groups; eggs have been combined with meats.
Minimum Dietary Diversity	Four_of6	From Food_grps_tot1, Food_grps_tot2b, and Food_grps_tot3b; Values: 1=child ate at 4 or more foods out of 6 possible food groups 0=child ate less than 4 foods out of 6 possible food groups	
	Four_of7	From Food_grps_tot2 and Food_grps_tot3; Values: 1=child ate at 4 or more foods out of 7 possible food groups 0=child ate less than 4 foods out of 7 possible food groups	Missing for survey 1.
	Three_of6	From Food_grps_tot1, Food_grps_tot2b, and Food_grps_tot3b; Values: 1=child ate at 3 or more foods out of 6 possible food groups 0=child ate less than 3 foods out of 6 possible food groups	
	Three_of7	From Food_grps_tot2 and Food_grps_tot3; Values: 1=child ate at 3 or more foods out of 7 possible food groups 0=child ate less than 3 foods out of 7 possible food groups	Missing for survey 1.

		possible food groups	
Minimum Meal Frequency	TotMeals	From M39 (survey 1 and survey 3), and S472 (survey2); Values: 0 to 7: number of times child ate in the previous 24 hours.	“Don’t know” recoded as missing. Value 7 includes 7 or more feeding times.
	MinFreq	From BFnow, HW1, and M39 (survey 1 and 3) or S472 (survey2); Values: 1=meeting the minimum meal frequency of: • 2+ times for breastfeeding 6 to 8 month olds, • 3+ times for breastfeeding 9 to 23 month olds, and • 4+ times for non-breastfeeding 6 to 23 month olds 0=not meeting the minimum meal frequency as described above	“Don’t know” recoded as missing. Missing if M39 (survey 1 and 3) or S472 (survey 2) variable is missing.
	MinFreq2	From BFnow, HW1, and TotMeals; Values: 1=meeting the minimum meal frequency of: • 2+ times for breastfeeding 6 to 8 month olds, • 3+ times for breastfeeding 9 to 23 month olds, and • 4+ times for non-breastfeeding 6 to 23 month olds 0=not meeting the minimum meal frequency as described above	Missing if TotMeals variable is missing.
	MinFreq3	From BFnow, HW1, and TotMeals; Values: 1=meeting the minimum meal frequency of: • 2+ times for breastfeeding 6 to 8 month olds, • 3+ times for breastfeeding 9 to 23 month olds, and • 3+ times for non-breastfeeding 6 to 23 month olds (equals the number of feedings for breastfed children since number of milk feeds are not available) 0=not meeting the minimum meal frequency as described above	Missing if TotMeals variable is missing.
Minimum Acceptable	MinDiet	From MinFreq and Four_of6; Values: 1=child meets minimum meal	Missing if either component variable is missing.

Diet		frequency described in MinFreq and the minimum dietary diversity described in Four_of6	
	MinDiet2	From MinFreq3 and Four_of6; Values: 1=child meets minimum meal frequency described in MinFreq3 and the minimum dietary diversity described in Four_of6	Missing if either component variable is missing.
	MinDiet3	From MinFreq3 and Three_of6; Values: 1=child meets minimum meal frequency described in MinFreq3 and the minimum dietary diversity described in Three_of6	Missing if either component variable is missing.
	IronRich	From MeatEggs (survey1); Organ2, Meat2, Poultry2, Eggs2, and Fish2 (survey 2); and Eggs, Meat, Organs, Fish (survey 3); Vales: 1=child had iron rich foods in last 24 hours 0=else	Missing only if all of component variables are missing.
	Feed_stat	From BFnow, AnySSS, AnyLiq, and EBF; Values: 1=non-breastfeeding 2=breastfeeding and receiving solid, semi-solid, or soft foods 3=breastfeeding and receiving other liquids 4=exclusively breastfeeding	
Section 4: Access to Health Services			
Place of delivery	Del_place	From M15; Values: 1=home 2=public facility 3=private facility (private hospital/NGOs 4=other	
	D_HomeDel	From Del_place; Values: 1=home delivery 0=public or private facility delivery	“Other” converted to missing
	D_HomeDel2	From Del_place; Values: 1=home delivery 0=public, private, or other facility delivery	
Has Health Card	Hcard	From H1; Values: 1=has health card 0=does not have health card	Yes, has health card value 1 includes those reported to have card but not seen by enumerator.
Antenatal Care	PreCare11	From M2A, M2B, M2C, and M2N; Values:	Survey 3 only.

		0=mother saw no one for antenatal care 1= mother saw doctor for antenatal care 2=mother saw nurse or midwife for antenatal care 3=mother saw HEW for antenatal care	
	D_PreCare	From M2A and M2N (survey 1); M2D, M2E, and 2N (survey 2); and M2A, M2B, M2C, and M2N (survey3); Values: 1=mother saw any health professional, HEW or community health worker for antenatal care 0=else	
	AnteVisits	From M14; Values: 0 through 24 number of antenatal visits; Values: 0 to	“Don’t know” converted to missing.
	D_AnteVisits	From M14; Values: 0=0 antenatal visits 1=1 or more antenatal visits	“Don’t know” converted to missing.
Measles Immunization	Measles	From H9; Values: 0=no measles vaccination 1=yes, received measles vaccination	“Don’t know” converted to missing. Yes includes: vaccination date on card, vaccination marked on card, and reported by mother.
Child recently sick	Diarrhea	From H11; Values: 1=child recently (in last 2 weeks) had diarrhea 0= child did not have diarrhea in the last two weeks	“Don’t know” converted to missing.
	Fever	From H22; Values: 1=child recently (in last 2 weeks) had fever 0= child did not have fever in the last two weeks	“Don’t know” converted to missing.
	Cough	From H31; Values: 1=child recently (in last 2 weeks) had cough 0= child did not have cough in the last two weeks	“Don’t know” converted to missing.
	FevCough	From Fever and Cough; Values: 1=child recently (in last 2 weeks) had fever or cough 0= child did not have fever or cough in the last two weeks	
	Sick	From Diarrhea, Fever, and Cough; Values:	

		1=child recently (in last 2 weeks) had diarrhea, fever, or cough 0= child did not have diarrhea, fever, or cough in the last two weeks	
Diarrhea treatment	DiaTreat	From H12Y and H12Z; Values: 0=no treatment sought for child's diarrhea 1=non-medical treatment sought for child's diarrhea 2=medical treatment sought for child's diarrhea	Missing for all cases with Diarrhea=0.
	D_anyDiaTreat	From H12Y; Values: 0=no treatment sought for diarrhea 1=any treatment (medical or non-medical) sought for diarrhea	Missing for all cases with Diarrhea=0.
	D_MedDiaTreat	From H12Z; Values: 0=no treatment or non-medical treatment sought for diarrhea 1=medical treatment sought for diarrhea	Missing for all cases with Diarrhea=0.
	DiaTreatType	From H12A through H12X; Values: 0=no treatment sought for diarrhea 1=non-medical treatment (shop, drug vendor, pharmacy, traditional practitioner, other) sought for diarrhea 2= government or community facility medical treatment sought for diarrhea 3=private or NGO facility medical treatment sought for diarrhea	Missing for all cases with Diarrhea=0.
Other Variables			
Child id	id	$= (1 * MIDX) + (10 * V003) + (1,000 * V002) + (1,000,000 * V001) + (1,000,000,000 * survey)$	This is a unique child identifier by year.
Woman/ mother id	WomanID	$= (10 * V003) + (1,000 * V002) + (1,000,000 * V001) + (1,000,000,000 * survey)$	This is a unique woman identifier by year.
Household id	HouseHoldID	$= (1,000 * V002) + (1,000,000 * V001) + (1,000,000,000 * survey)$	This is a unique household identifier by year.
Cluster id	ClusterID	$(1,000,000 * V001) + (1,000,000,000 * survey)$	This is a unique cluster identifier by year.
Survey year	Survey	From V000; Values: 1=2000 2=2005 3=2011 4=2014	
Weight	Weight	$= V005 / 1000000$	This is the recommended weighting variable from DHS.
Alternate	JMweight	$= V005 / \text{mean of } V005 \text{ for each}$	

weight		survey	
Mothers height	R_height	From V438 (respondant's height in cm, 1 decimal) Cleaned to the correct decimal place and removed 999's.	Missing for survey 4. n=223 removed to missing (999's).
	R_height2	From R_height; Removed extreme values to range of 140 to 180 cm.	Missing for survey 4. n=127 to missing (out of range).
Lying/ standing	D_lying	From HW15; Values: 1=length, measured lying 0=height, measured standing	"Not measured" recoded as missing.
	mgood	From HW15 and HW1; Values 1=correctly measured for age 0=incorrectly measured for age	Note some incorrect measurements may be correct for actual age, but appear incorrect due to age misreporting. This issue is discussed further in the text.

Table 2.1 B Definitions of WHO indicators for assessing infant and young child feeding and definition alterations used for this analysis.

Indicator	WHO Definition	Population • Recommended disaggregation	Definition used in this analysis (if altered from WHO definition)
Core Indicators			
1. Early initiation of breastfeeding	Proportion of children born in the last 24 months who were put to the breast within one hour of birth.	Children born in the last 24 months. • 0 to 12 months • 12 to 24 months	
2. Exclusive breastfeeding under 6 months	Proportion of infants 0 to 5 months of age who are fed exclusively with breastmilk.	Infants 0 to 5 months of age. • 0 to 1 months • 2 to 3 months • 4 to 5 months • 0 to 3 months	
3. Continued breastfeeding at 1 year	Proportion of children 12 to 15 months of age who are fed breastmilk.	Children 12 to 15 months of age.	
4. Introduction of solid, semi-solid or soft foods	Proportion of infants 6 to 8 months of age who receive solid, semi-solid or soft foods.	Infants 6 to 8 months of age	
5. Minimum dietary diversity	Proportion of children 6 to 23 months of age who receive foods from 4 or more food groups of the following food groups: 1. Grains, roots and tubers 2. Legumes and nuts 3. Dairy products 4. Flesh foods 5. Eggs 6. Vitamin A rich foods 7. Other fruits and vegetables	Children 6 to 23 months of age. • 6 to 11 months • 12 to 17 months • 18 to 23 months • report breastfed and non-breastfed separately	Proportion of children 6 to 23 months of age who receive foods from 3 or more food groups of the following 6 food groups: 1. Grains, roots and tubers 2. Legumes and nuts 3. Dairy products 4. Eggs and flesh foods 5. Vitamin A rich foods 6. Other fruits and

			vegetables
6. Minimum meal frequency	Proportion of breastfed and non-breastfed children 6 to 23 months of age who receive solid, semi-solid or soft foods (but also including milk feeds for non-breastfed children) the minimum times or more. Minimum is defined as: • 2 times for breastfed infants 6 to 8 months • 3 times for breastfed children 9 to 23 months • 4 times for non-breastfed children 6 to 23 months	Calculate from two separate fractions for breastfed children and non-breastfed children 6 to 23 months of age. • 6 to 11 months • 12 to 17 months • 18 to 23 months	Proportion of breastfed and non-breastfed children 6 to 23 months of age who receive solid, semi-solid or soft foods the minimum times or more. Minimum is defined as: • 2 times for breastfed infants 6 to 8 months • 3 times for breastfed children 9 to 23 months • 3 times for non-breastfed children 6 to 23 months
7. Minimum acceptable diet	Proportion of children 6 to 23 months of age who receive a minimum acceptable diet (apart from breastmilk). Different definitions for breastfed and non-breastfed: • breastfed children who had at least the minimum dietary diversity and the minimum meal frequency the previous day • non-breastfed children who received at least 2 milk feedings, had the minimum dietary diversity not including milk feeds and had the minimum meal frequency the previous day	Calculate from two separate fractions for breastfed children and non-breastfed children 6 to 23 months of age. • 6 to 11 months • 12 to 17 months • 18 to 23 months	Proportion of children 6 to 23 months of age who receive a minimum acceptable diet. Does not take into account milk feeds. • breastfed and non-breastfed children who had at least the minimum dietary diversity (as defined above in this column) and the minimum meal frequency for their age group (as defined above in this column) the previous day
8. Consumption of iron-rich or iron-fortified foods	Proportion of children 6 to 23 months of age who receive an iron-rich foods or iron-fortified food that is specially designed for infants and young children or that is fortified in the home.	Children 6 to 23 months of age. • 6 to 11 months • 12 to 17 months • 18 to 23 months	

Table 2.2A Cases with non-missing height, weight, and age by survey year. (un-weighted)

Survey	Total cases	Non-missing: age (0-59 mos) / height	ZHAZCL Valid (range: -5.0 to 4.5)	Cases remaining / removed by Mgood = 0
Survey 1 (2000)	10,873	9,560 / 9,084	8,549	8,022 / 512
Survey 2 (2005)	9,861	4,455 / 4,206	3,789	3,456 / 324
Survey 3 (2011)	11,654	10,480 / 9,893	9,480	8,123 / 1,287
Survey 4 (2014)	5,579	5,068 / 4,858	4,358	4,062 / 296
Total	37,967	29,563 / 28,041	26,176	23,663 / 2,419 (+94 missing listwise)*

* Missing on variable HW15 – height: lying or standing (no cases missing this variable in survey 4).

Table 2.2B Frequency table of variable ‘result of measurement – height/weight’ (HW13), excluding HW13=0 (measurement taken), from survey 3.

	Frequency	Percent	Valid Percent	Cumulative Percent
Dead	846	50.2	50.2	50.2
Not present	161	9.5	9.5	59.7
Refused	252	14.9	14.9	74.7
Other	99	5.9	5.9	80.5
No measurement found in household	328	19.5	19.5	100.0
Total	1686	100.0	100.0	

Table 2.3. Descriptive statistics of new Haz variable (cleaned from HW70) restricted to range of -5.0 to 4.5, survey 3 only, by age group.

Age group	N	Minimum	Maximum	Mean	Std. Deviation
0 to 23	3451	-4.98	3.99	-.9319	1.72600
24 to 59	4582	-5.00	3.58	-1.7227	1.38852
Total: 0 to 59	9357	-5.00	3.99	-1.5480	1.63536

Table 2.4. A. Frequency of cases with height measured lying and standing by age group. (survey 3, un-weighted)

Age Group (months)	Lying		Standing		N
	Frequency	Percent	Frequency	Percent	
Total sample					
0 to 23	3658	88.5%	204	4.9%	3862
24 to 59	1241	19.5%	4723	74.4%	5964
Ages around 2 years					
21 to 23	317	83.0%	53	13.9%	370
24 to 26	314	54.6%	229	39.8%	543

Table 2.4 B. Mean height in millimeters by month of age and height measurement type. (survey 3, un-weighted)

Age in months	Measurement type	Mean	N	Std. Deviation
20	Lying	775.05	99	49.874
	Standing	822.18	22	72.370
	Total	783.62	121	57.281
21	Lying	782.05	122	52.007
	Standing	804.60	15	55.229
	Total	784.52	137	52.634
22	Lying	778.18	103	44.341
	Standing	829.53	19	61.476
	Total	786.18	122	50.686
23	Lying	788.92	92	48.091
	Standing	808.68	19	59.200
	Total	792.31	111	50.425
24	Lying	793.71	111	48.937
	Standing	833.24	59	60.781
	Total	807.43	170	56.416
25	Lying	796.14	105	56.577
	Standing	835.81	91	59.892
	Total	814.56	196	61.288
26	Lying	791.46	97	53.082
	Standing	837.23	79	66.242
	Total	812.01	176	63.424
27	Lying	798.04	78	46.028
	Standing	828.52	93	58.476
	Total	814.61	171	55.154
28	Lying	803.47	90	46.749
	Standing	838.54	78	67.684
	Total	819.75	168	59.873

29	Lying	801.39	70	49.565
	Standing	837.52	103	68.269
	Total	822.90	173	63.764
30	Lying	808.84	56	44.495
	Standing	863.29	82	52.367
	Total	841.20	138	56.003

Table 2.5. Percent mismeasured for height/ length by survey year. (un-weighted)

Survey	% mismeasured length/height			
	standing when should be lying		lying when should be standing	
	<24 mo	18-23 mo	>=24 mo	24-29 mo
Survey 1 (2000)	7.1% (3,632)	16.2% (834)	5.8% (5439)	17.3% (1019)
Survey 2 (2005)	15.2% (1,653)	35.1% (342)	5.2% (2543)	15.7% (433)
Survey 3 (2011)	5.0% (4,071)	12.3% (813)	19.8% (6266)	50.2% (1099)
Survey 4 (2014)	11.4% (1,859)	30.2% (344)	4.7% (3208)	13.6% (639)
Total	8.3% (11,215)	19.7% (2,333)	10.6% (17456)	27.7% (3190)

Table 2.6. Height/length measurements 18-23 and 24-30 months, 2011 survey.

Group	Measurement	HAZ	Height (cms)	Prevalence	N
18-23 months	Wrong (standing)	-1.053	81.1	35.4	96
	Correct (lying)	-2.024	77.3	52.0	662
	Total	-1.901	77.8	49.9	758
24-30 months	Wrong (lying)	-2.435	79.7	63.4	571
	Correct (standing)	-1.430	83.9	36.7	559
	Total	-1.938	81.8	50.2	1130
18-30 months	Wrong (lying)	-2.237	79.9	59.4	667
	Correct (standing)	-1.752	80.4	45.0	1221
	Total	-1.923	80.2	50.1	1888

Table 2.7 Regional location and number of cases lost from clusters missing geographical data.

Region	Total clusters missing geo data	Total cases within clusters missing geo data ^a	Total cases in region (mgood=1) ^a	Percent of cases lost due to missing geo data
Tigray	2	13	948	1.37%
Afar	2	8	811	0.99%
Amhara	2	13	939	1.38%
Oromiya	3	22	1413	1.56%
Somali	8	146	658	22.19%
Benishangul-Gumuz	1	14	710	1.97%
SNNP	1	7	1110	0.63%
Gambela	5	38	584	6.50%
Harari	0	0	431	0.0%
Addis Ababa	0	0	298	0.0%
Dire Dawa	1	1	479	0.
Total	25	270	8381	3.22%

^a The number of cases from the clusters that are missing geographical data are listed un-weighted, and are among only those cases with the correct height measurement (lying or standing) for their age, represented as the total cases in region, which is also un-weighted.

Table 2.8 Zones with fewer than 30 un-weighted cases from EDHS 2011.

Region	Zone Name	Number of un-weighted cases in Zone ^a
Tigray	Mekele Special Zone	14
Amhara	Bahir Dar Liyu	3
Somali	Dege Habur	0 – No DHS data
	Welwel & Warder	0 – No DHS data
SNNP	Amaro Special Woreda	13
	Basketo Special Woreda	0 – No DHS data
	Burji Special Woreda	0 – No DHS data
	Derashe Special Woreda	19
	Konso Special	20
	Konto Special Woreda	0 – No DHS data
	Sheka	12
	Yem Special Woreda	0 – No DHS data
Addis Ababa	Zone 1	11
	Zone 4	26
	Zone 6	19

Zones with 0 cases, no DHS data, are shaded grey to indicate missing data.

Zones with fewer than 30 cases are primarily special woreda's, and therefore smaller in size than most normal zones, and are often not even seen on the maps presented. Therefore they are not shaded out in any way. However, if zones with fewer than 30 un-weighted cases fall into high-need priority zones, it will be should be kept in mind that the designation is based on a small sample size.

^a The number of cases are listed un-weighted, and are among only those cases with the correct height measurement (lying or standing) for their age, represented as the total cases in region, which is also un-weighted.

2.B Trends and differentials in nutritional status – Tables

Table 2.9 Rates of improvement in stunting in children 0-5years, ppts/year change, from present calculations and from DHS estimates, plus 2011 prevalences, by region.

Rates (ppts/yr)	Our estimates	From DHS	Prevalence 2011
National	-1.46	-1.13	39.1
Tigray	-1.18	-0.80	47.0
Amhara	-1.24	-0.88	46.6
Oromiya	-1.35	-1.04	37.7
SNNP	-1.88	-1.47	35.3
Affar	-0.77	-0.27	42.6
Somali	-1.63	-1.74	26.3
B-G	-0.54	0.12	42.1
Gambela	-1.58	-1.44	22.0
Harari	-1.76	-1.24	22.3
Addis Ababa	-1.17	-0.99	19.4
Dire Dawa	-0.64	-0.04	27.6

Table 2.10 Malnutrition indicators by livelihood.

Population proportion and prevalence of stunting, wasting and underweight in each livelihood group in 2011 (weighted)

Livelihood	Population %	Prevalence of stunting	Prevalence of underweight	Prevalence of wasting
Agriculturalist	78.1%	39.9%	26.5%	10.0%
Agro-pastoralist	9.6%	40.1%	27.2%	11.3%
Pastoralist	7.6%	38.7%	26.8%	11.3%
Missing (livelihood)	4.7%			
National total	100.0%	39.8%	26.6%	10.3%

Table 2.11 Mean HAZ for lowest decile of HAZ distribution, by survey year 2000 -14

Survey	Mean for first decile of HAZ	P	Povcat (asset-poverty) %	Overall mean HAZ
2000	-4.827		44.5	-2.0397
2005	-4.827	Cf 2000: p=0.997	29.5	-1.7202
2011	-4.278	Cf 2000: p=0.000 Cf 2005: p=0.000	17.4	-1.4125
2014	-4.467	Cf 2011: p=0.000 Cf 2005: p=0.000	13.5	-1.3259

Note: to calculate lowest decile HAZ, constraint of excluding values < - 5SDs was removed.

Table 2.12 Variables used in cluster effects analysis.

Household/individual level	Cluster level
Poverty: dummy povcat = 1 if dummies for unimproved water <u>and</u> toilet <u>and</u> roof = 1	Mean by cluster (continuous), dichotomized at mean for each survey (0.48, 0.17), gives dummy (DPovcatS1 and ...S3, for surveys 1 and 3).
Water source: surface water (spring, pond, rainwater, etc), dummy (D_SurfaceWat)	Mean by cluster (continuous), dichotomized at mean for each survey (0.81, 0.58), gives dummy (DCI_SurfaceS1 and ...S3, for surveys 1 and 3).
Toilet: no facility, dummy (D_NoToilet)	Mean by cluster (continuous), dichotomized at mean for each survey (0.86, 0.38), gives dummy (DCI_NoToiletS1 and ...S3, for surveys 1 and 3).
Roof: grass/thatch, dummy (D_PoorRoof2)	Mean by cluster (continuous), dichotomized at mean for each survey (0.73, 0.55), gives dummy (DCI_PoorRoof2S1 and ...S3, for surveys 1 and 3).
Education: no education (V106, respondent), dummy (D_NoEd)	Mean by cluster (continuous), dichotomized at mean for each survey (0.82, 0.58), gives dummy (DCI_NoEdS1 and ...S3, for surveys 1 and 3).

Table 2.13 Child height-for-age (HAZ) by age at first birth of mother and age of child (Ethiopia).

In cells: mean HAZ score (n)

Age of child (months)	Maternal age at first birth (years)			Total	p-value
	15-17	18-19	20-24		
0-11	-1.69(50)	-0.27(114)	-0.37(148)	-0.55 (312)	0.00
12-23	-1.83(67)	-1.54(75)	-1.47(131)	-1.58 (273)	0.269
24-35	-1.87(81)	-1.96(82)	-2.24(130)	-2.06 (294)	0.130
36-47	-2.27(108)	-1.85(83)	-2.02(180)	-2.06 (371)	0.054
48-59	-2.18(95)	-1.55(88)	-1.78(167)	-1.83 (350)	0.002
Total	[-1.501]* 402	[-1.429] 442	[-1.536] 757	1600	0.477

* Estimates in []s recalculated from current dataset, and need to harmonized with 2013 calculations.

Table 2.14 Comparison of adjusted (maternal education and maternal height) effect sizes of low maternal age on child HAZ.

Differences in height-for-age, by mothers' age at birth, by child's age band other countries

(only significant bivariate associations included)

Country (Year)	Child Age (months)	Effect Size (bivariate) HAZ units (p-value)	Coefficient for maternal age group dummy with HAZ dependent variable when controlling for education and maternal height	Effect size found between mothers' age at first birth / reference age group	N (multivariate)
Burkina Faso (2010)	24-35	-0.62 (0.025)	-0.271, (0.272)	15-17 / 18-24	221
	36-47	-0.57 (0.016)	-0.394, (0.059)	15-17 / 18-24	231
	48-59	-0.42 (0.022)	-0.326, (0.118)	15-17 / 18-24	187
Egypt (2008)	0-59	None significant	--	--	--
Ethiopia (2011)	0-11	-1.42 (<0.001)	-0.342, (0.133)	15-17 / 18-24	306
	36-47	-0.42 (0.054)	-0.263, (0.073)	15-17 / 18-24	340
	48-59	--0.63 (0.002)	-0.202, (0.176)	15-17 / 18-24	316
Mali (2007)	0-59	None significant	--	--	--
Mozambique (2011)	24-35	-0.71 (0.004)	-0.332, (0.034) ^a	15-17 / 18-24	243
	36-47	-0.58 (0.079)	-0.463, (0.065) ^a	15-17 / 18-24	131
Niger (2006)	24-35	-1.11 (0.016)	-0.157, (0.716)	15-17 / 18-24	94

Note – Data were taken from each country's DHS, except for Serbia, Vietnam and Mozambique, where MICS data was used.

(a): Controlling for education only (maternal height not available).

The negative sign for the coefficients is equivalent to the positive effect size, due to how the models were set up.

Table 2.15 Prevalence of child stunting (HAZ <-2SDs) by age at first birth of mother and age of child (Ethiopia).

Age of child (months)	Maternal age at first birth (years)			Total	p-value
	15-17	18-19	20-24		
0-11	36.4 (50)	17.7 (110)	19.8 (140)	21.8 (299)	0.022
12-23	46.9 (68)	34.2 (75)	47.8 (129)	43.8 (272)	0.143
24-35	58.7 (80)	53.3 (86)	59.9 (132)	57.7 (299)	0.617
36-47	60.7 (108)	49.9 (88)	54.4 (184)	55.2 (380)	0.311
48-59	55.0 (95)	36.4 (88)	40.4 (171)	43.4 (354)	0.022
Total	[39.6]* 401	[39.4] 447	[38.0] 755	1604	0.880

* Estimates in []s recalculated from current dataset, and need to harmonized with 2013 calculations.

2.C Risk factors: correlates of malnutrition as basis for extending interventions to further improve child nutrition – Tables

2.C Risk factors: Water and Sanitation (WASH) – Tables

Table 2.16 Associations of water supply and toilet with height-for-age by age group, 2011.

Dependent variable: HAZ; in cells: coefficient (t,p) n.

Age <24 months	
Water (surface)	-0.224 (-4.170, 0.000) n=3420
Toilet (no improved toilet)	-0.150 (-2.794, 0.005) n=3421
Age >= 24 months	
Water (surface)	-0.230 (-5.536, 0.000) n=4554
Toilet (no improved toilet)	-0.103 (-2.472, 0.013) n=4554

Dependent variable: HAZ

Independent variables: age, gender, water source OR toilet dummy variables.

Mgood=1, un-weighted.

Table 2.16 Interaction of poor water source and no toilet on height-for-age by age group, 2011.

Dependent variable: HAZ; in cells: coefficient (t,p) n.

Age <24 months	
Water * Toilet ¹	0.067 (0.617, 0.537) n=3419
Age >= 24 months	
Water * Toilet ¹	0.020 (0.234, 0.815) n=4551

1. water * toilet indicates the interaction term of poor water source multiplied by no toilet.

Dependent variable: HAZ

Independent variables: age, gender, poor water, no toilet, interaction of poor water and no toilet, no education, and poor roofing.

Mgood=1, un-weighted.

Table 2.17 The association of poor water and sanitation (no toilet) with height-for-age, ages less than 24 months, 2011.

Dependent variable: HAZ; in cells: Coefficient (t,p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Age in months		-0.122 (-29.708, 0.000)	-0.122 (-29.818, 0.000)	-0.122 (-29.972, 0.000)	-0.122 (-29.947, 0.000)	-0.122 (-29.953, 0.000)	-0.123 (-30.195, 0.000)	-0.121 (-30.657, 0.000)	-0.121 (-30.669, 0.000)
Sex of child		0.121 (2.258, 0.024)	0.119 (2.221, 0.026)	0.120 (2.240, 0.025)	0.121 (2.260, 0.024)	0.119 (2.237, 0.025)	0.117 (2.210, 0.027)	0.123 (2.386, 0.017)	0.124 (2.400, 0.016)
Poor Water Supply	-0.171 (-2.832, 0.005)	-0.224 (-4.170, 0.000)	-0.302 (-3.883, 0.000)	-0.254 (-2.386, 0.017)	-0.144 (-2.626, 0.009)	-0.137 (-2.495, 0.013)	-0.101 (-1.832, 0.067)	-0.049 (-0.904, 0.366)	-0.052 (-0.966, 0.334)
No Education				-0.394 (-5.036, 0.000)	-0.369 (-6.287, 0.000)	-0.487 (-6.229, 0.000)	-0.422 (-5.341, 0.000)	-0.365 (-4.737, 0.000)	-0.265 (-4.621, 0.000)
Interaction: Poor Water Supply* No Education				0.071 (-0.598, 0.550)					
No Toilet			-0.210 (-2.757, 0.006)	-0.115 (-1.472, 0.141)	-0.058 (-1.052, 0.293)	-0.238 (-2.472, 0.013)	-0.155 (-1.594, 0.111)	-0.283 (-2.986, 0.003)	-0.131 (-2.445, 0.015)
Interaction: Poor Water Supply* No Toilet			0.185 (1.702, 0.089)	0.118 (1.076, 0.282)					
Interaction: No Education* No Toilet						0.265 (2.279, 0.023)	0.166 (1.403, 0.161)	0.223 (1.946, 0.052)	
Poor Roofing							-0.254 (-4.593, 0.000)	-0.270 (-5.013, 0.000)	-0.288 (-5.448, 0.000)
Mother's height								0.061 (14.919, 0.000)	0.061 (14.864, 0.000)
Constant	-0.834	0.304	0.405	0.586	0.544	0.609	0.689	-8.986	-8.997
Adj. R Square	0.002	0.207	0.209	0.217	0.217	0.218	0.223	0.272	0.271
N	3420	3420	3420	3420	3420	3420	3419	3398	3398

Dependent variable: HAZ

Independent variables: age, sex, poor water source, no education, interaction of poor water and no education, no toilet, interaction of no toilet and no education, interaction of poor water and no toilet, poor roofing, and mother's height.

Mgood=1, un-weighted.

Table 2.18 Interaction: Adjusted height-for-age and prevalence of stunting by toilet and education, ages less than 24 months, 2011.

In cells: Adjusted mean HAZ *or* adjusted prevalence of stunting, standard error [90% Confidence Interval] adjusted prevalence of stunting; n in group; difference in HAZ/ p-value's for HAZ.

		No Toilet (bush/ field)	Any Toilet	Row HAZ diff. / p-value	Total (by Education)
No education	HAZ	-1.042, se=0.042 [-1.111, -0.973]	-0.982, se=0.049 [-1.063, -0.900]	-0.06/ 0.3537	-1.012, se=0.032 [-1.065, -0.958]
	Prev. HAZ < -2	0.317, se=0.011 [0.298, 0.335]	0.266, se=0.013 [0.245, 0.288]		0.291, se=0.009 [0.277, 0.306]
	n	1317	942		2259
Any education	HAZ	-0.900, se=0.074 [-1.022, -0.778]	-0.617, se=0.058 [-0.713, -0.512]	-0.283/ 0.0028	-0.759, se=0.047 [-0.836, -0.681]
	Prev. HAZ < -2	0.271, se=0.020 [0.238, 0.304]	0.205, se=0.016 [0.179, 0.230]		0.238, se=0.012 [0.217, 0.258]
	n	421	718		1139
Column HAZ diff. / p-value		0.142/ 0.09560	-0.365/ 0.0000		
Total (By toilet)	HAZ	-0.971, se=0.043 [-1.041, -0.901]	-0.799, se=0.038 [-0.861, -0.737]		
	Prev. HAZ < -2	0.294, se=0.011 [0.275, 0.312]	0.236, se=0.010 [0.219, 0.252]		
	n	1738	1660		

Mgood=1, un-weighted.

Adjusted for covariates at the following values (sample means): child's age in months=10.61, child's gender=1.50, poor water source=0.4956, poor roof=0.53, and mother's height in cm=157.1825.

Mean adjusted for: child's age in months, child's gender, poor water source, poor roof, and mother's height in cm.

Table 2.19 Assessing the effect of poor water and sanitation (no toilet) on height-for-age, ages 24 months and older, 2011.

Dependent variable: HAZ; in cells: coefficient (t,p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Age in months		-0.012 (-5.739, 0.000)	-0.012 (-5.775, 0.000)	-0.013 (-5.801, 0.000)	-0.012 (-5.680, 0.000)	-0.012 (-5.716, 0.000)	-0.012 (-5.713, 0.000)	-0.012 (-5.589, 0.000)	-0.011 (-5.044, 0.000)
Sex of child		0.054 (1.296, 0.195)	0.052 (1.253, 0.210)	0.053 (-5.801, 0.000)	0.056 (1.352, 0.176)	0.055 (1.329, 0.184)	0.055 (1.326, 0.185)	0.054 (1.314, 0.189)	0.057 (1.407, 0.160)
Poor Water Supply	-0.230 (-5.527, 0.000)	-0.230 (-5.536, 0.000)	-0.261 (-4.361, 0.000)	-0.222 (-5.285, 0.000)	-0.427 (-5.225, 0.000)	-0.427 (-5.162, 0.000)	-0.423 (-5.166, 0.000)	-0.375 (-4.523, 0.000)	-0.357 (-4.391, 0.000)
No Education					-0.395 (-6.524, 0.000)	-0.379 (-5.406, 0.000)	-0.390 (-6.360, 0.000)	-0.363 (-5.887, 0.000)	-0.349 (-5.782, 0.000)
Interaction: Poor Water Supply* No Education					0.329 (3.455, 0.001)	0.330 (3.426, 0.001)	0.326 (3.417, 0.001)	0.295 (3.090, 0.002)	0.334 (3.561, 0.000)
No Toilet			-0.107 (-1.818, 0.069)	-0.069 (-1.643, 0.101)		-0.002 (-0.030, 0.976)	-0.024 (-0.565, 0.572)	-0.015 (-0.351, 0.726)	-0.070 (-1.673, 0.094)
Interaction: Poor Water Supply*No Toilet			0.078 (0.925, 0.355)						
Interaction: No Education* No Toilet						-0.029 (-0.304, 0.761)			
Poor Roofing								-0.155 (-3.646, 0.000)	-0.167 (-4.000, 0.000)
Mother's height									0.045 (13.637, 0.000)
Constant	-1.594	-1.134	-1.081	-1.097	-0.895	-0.890	-0.883	-0.853	-8.069
Adj. R Square	0.006	0.014	0.014	0.014	0.022	0.022	0.022	0.025	0.064
N	4554	4554	4552	4552	4554	4552	4552	4551	4508

Dependent variable: HAZ

Independent variables: age, sex, poor water source, no education, interaction of poor water and no education, no toilet, interaction of no toilet and no education, interaction of poor water and no toilet, poor roofing, and mother's height.

Mgood=1, un-weighted.

Table 2.20 Interaction: Adjusted mean height-for-age and prevalence of stunting by water source and education, ages 24 months and older, 2011.

In cells: Adjusted mean HAZ / adjusted prevalence of stunting, standard error [90% Confidence Interval]; n in group; difference in HAZ/ p-value's for HAZ.

		Poor Water Supply (surface or rainwater)	Good Water Supply	Row HAZ diff. / p-value	Total (by Education)
No education	HAZ	-1.792, se=0.033 [-1.846, -1.739]	-1.769, se=0.036, [-1.828, -1.710]	-0.023/ 0.639	-1.781, se=0.024, [-1.821, -1.741]
	Prev HAZ	0.465, se=0.012	0.442, se=0.013		0.454, se=0.009
	< -2	[0.446, 0.484]	[0.421, 0.463]		[0.439, 0.468]
	n	1802	1431		3233
Any education	HAZ	-1.777, se=0.065, [-1.884, -1.670]	-1.420, se=0.049, [-1.500, -1.340]	-0.357/ 0.000	-1.599, se=0.041 [-1.665, -1.532]
	Prev HAZ	0.458, se=0.023	0.347, se=0.017		0.403, se=0.014
	< -2	[0.421, 0.496]	[0.319, 0.375]		[0.379, 0.426]
	n	441	834		1275
Column HAZ diff. / p-value		-0.015 / 0.8395	-0.349/ 0.000		
Total (By water)	HAZ	-1.785, se=0.036, [-1.845, -1.725]	-1.595, se=0.030, [-1.644, -1.545]		
	Prev HAZ	0.462, se=0.013	0.394, se=0.011		
	< -2	[0.441, 0.483]	[0.377, 0.412]		
	n	2243	2265		

Mgood=1, un-weighted.

Adjusted for: child's age in months=43.48, child's gender=1.47, no toilet=0.51, poor roof=0.50, and mother's height in cm=157.6569.

Table 2.21 Distribution of source of drinking water among children 24 months and older, 2011.

	Frequency	Percent	Valid Percent	Cumulative Percent
Piped	305	6.5	6.5	6.5
Public tap	921	19.5	19.8	26.3
Well	1005	21.3	21.6	47.9
Surface and rainwater	2332	49.4	50.0	97.9
Other	98	2.1	2.1	100.0
Total	4661	98.7	100.0	
Missing	62	1.3		
Total	4723	100.0		

Mgood=1, un-weighted.

Table 2.22 Mean height-for-age and prevalence of stunting by source of drinking water among children 24 months and older, 2011.

Source of drinking water		HAZ	Prevalence of stunting (HAZ<-2)
Piped	Mean	-1.1723	.2458
	N	301	301
Public tap	Mean	-1.5774	.3761
	N	904	904
Well	Mean	-1.7807	.4496
	N	972	972
Surface and rainwater	Mean	-1.8389	.4800
	N	2252	2252
Other	Mean	-1.3635	.3871
	N	93	93
Total	Mean	-1.7199	.4352
	N	4522	4522
p-value		0.000	0.000

Mgood=1, un-weighted.

Table 2.23 Distribution of type of toilet among children 24 months and older, 2011.

	Frequency	Percent	Valid Percent	Cumulative Percent
Flush	118	2.5	2.5	2.5
Improved pit latrine (ventilated and slab)	477	10.1	10.2	12.8
Open pit latrine	1496	31.7	32.1	44.9
No toilet	2389	50.6	51.3	96.1
Other	181	3.8	3.9	100.0
Total	4661	98.7	100.0	
Missing	62	1.3		
Total	4723	100.0		

Mgood=1, un-weighted.

Table 2.24 Mean height-for-age by type of toilet among children 24 months and older, 2011.

Type of toilet facility		HAZ	Prevalence of stunting (HAZ<-2)
Flush	Mean	-1.1239	.2991
	N	117	117
Improved pit latrine (ventilated and slab)	Mean	-1.3373	.2812
	N	473	473
Open pit latrine	Mean	-1.8080	.4520
	N	1458	1458
No toilet	Mean	-1.7763	.4624
	N	2299	2299
Other	Mean	-1.7094	.4514
	N	175	175
Total	Mean	-1.7211	.4354
	N	4522	4522
p-value		0.000	0.000

Mgood=1, un-weighted.

Table 2.25 Regional mean height-for-age and prevalence of stunting, ages 24 months and older, 2011.

Region	HAZ	Prevalence of stunting (Haz <-2)	N
Tigray	-2.0489	.5073	550
Affar	-1.9633	.5335	448
Amhara	-1.9247	.4955	553
Oromiya	-1.8291	.4767	772
Somali	-1.4113	.3466	378
Benishangul-Gumuz	-2.0472	.5095	369
SNNP	-1.6810	.4417	566
Gambela	-.9778	.2351	302
Harari	-1.2481	.2941	238
Addis Ababa	-1.2575	.2403	154
Dire Dawa	-1.5251	.3571	252
Total	-1.7227	.4358	4582

Mgood=1, un-weighted.

Table 2.28 National distribution of source of drinking water in 2000, 2005 and 2011, all ages.
In cells: weighted % (weighted n in group/ un-weighted n in group).

	2000	2005	2011
Piped	2.1% (254/ 575)	2.8% (308/ 541)	4.4% (523/ 792)
Public tap/ piped outside of residence	10.6% (1302/ 1291)	14.0% (1561/ 1672)	20.9% (2482/ 2180)
Well	6.0% (740/ 1271)	10.1% (1127/ 1242)	14.8% (1754/ 2545)
Surface or rainwater	77.7% (9531/ 7357)	72.0% (8036/ 6229)	55.9% (6632/ 5594)
Other	0% (6/ 18)	0.4% (43/ 80)	1.2% (144/ 269)
Missing/ don't know	3.5% (427/ 361)	0.8% (88/ 97)	2.8% (338/ 274)
Total	100% (12260/ 10873)	100% (11163/ 9861)	100% (11872/ 11654)

Mgood=0 or 1, weighted.

Table 2.29 Regional mean height-for-age and prevalence of stunting by type of water source and education, all ages, 2011.

In cells: weighted HAZ, weighted prevalence <-2 HAZ, weighted n/ un-weighted n, p-values for difference in HAZ (only presented if both comparison groups have un-weighted n >=30).

Region			Piped	Public tap	Well	Surface/ Rain	Other
Tigray	Any/ some education	HAZ	-1.0915	-1.4552	-1.8515	-1.7947	NA
		Prev. <-2 HAZ	20.5%	27.3%	49.9%	53.8%	NA
		n (wtd/ un-wtd)	44/ 53	38/ 58	70/ 113	39/ 67	0/0
	No education	HAZ	-1.7572	-1.8173	-1.8964	-2.1172	-0.5281
		Prev. <-2 HAZ	48.8%	46.4%	46.4%	55.8%	0.0%
		n (wtd/ un-wtd)	10/ 15	41/ 65	171/ 274	157/ 262	2/ 3
	p-value		NA	0.183	0.804	0.172	NA
Affar	Any/ some education	HAZ	-1.3232	-1.7397	0.4218	-1.9936	1.0400
		Prev. <-2 HAZ	38.2%	32.7%	10.0%	43.5%	0.0%
		n (wtd/ un-wtd)	7/ 36	2/ 11	1/ 8	1/ 14	0/ 1
	No education	HAZ	-1.0714	-1.2141	-1.8615	-1.5198	-0.3540
		Prev. <-2 HAZ	43.5%	32.2%	50.6%	45.4%	16.8%
		n (wtd/ un-wtd)	3/ 15	8/ 76	16/ 176	41/ 403	2/ 8
	p-value		NA	NA	NA	NA	NA
Amhara	Any/ some education	HAZ	-1.2257	-1.3967	-1.8710	-1.9862	NA
		Prev. <-2 HAZ	26.8%	31.9%	53.8%	51.6%	NA
		n (wtd/ un-wtd)	50/ 19	91/ 40	36/ 19	135/ 70	0/0
	No education	HAZ	-2.0012	-1.8659	-1.8377	-1.7774	-1.3753
		Prev. <-2 HAZ	53.2%	45.7%	47.7%	46.3%	50.6%
		n (wtd/ un-wtd)	40/ 10	290/ 129	256/ 126	892/ 461	7/ 4
	p-value		NA	0.005	NA	0.120	NA
Oromiya	Any/ some education	HAZ	-0.3774	-1.3927	-1.6385	-1.4283	-1.2077
		Prev. <-2 HAZ	19.2%	33.6%	44.0%	40.7%	32.4%
		n (wtd/ un-wtd)	70/ 26	395/ 143	107/ 36	652/ 234	9/ 3
	No education	HAZ	-0.5099	-1.2929	-1.3022	-1.4471	-0.4523
		Prev. <-2 HAZ	17.4%	38.1%	34.2%	38.9%	31.4%
		n (wtd/ un-wtd)	18/ 7	513/ 174	273/ 96	1748/ 613	24/ 9
	p-value		NA	0.346	0.058	0.795	NA
Somali	Any/ some education	HAZ	-1.0948	-0.5442	0.2180	-0.3016	-0.4102
		Prev. <-2 HAZ	19.2%	7.9%	10.1%	8.4%	20.9%
		n (wtd/ un-wtd)	3/ 7	11/ 23	12/ 27	7/ 17	11/ 25
	No education	HAZ	-0.6388	-1.1621	-1.0238	-1.0161	-0.9011
		Prev. <-2 HAZ	31.4%	30.1%	29.2%	30.1%	28.2%
		n (wtd/ un-wtd)	5/ 15	26/ 87	65/ 170	57/ 179	27/ 78
	p-value		NA	NA	NA	NA	NA
Benishangul-Gumuz	Any/ some education	HAZ	0.2159	-1.8463	-1.7002	-1.4778	NA
		Prev. <-2 HAZ	13.6%	51.4%	49.3%	35.8%	NA
		n (wtd/ un-wtd)	2/ 7	4/ 22	8/ 60	10/ 83	0/0
	No education	HAZ	NA	-1.5333	-1.7392	-1.6112	NA
		Prev. <-2 HAZ	NA	38.6%	42.0%	43.8%	NA
		n (wtd/ un-wtd)	0/ 0	11/ 69	21/ 163	37/ 271	0/ 0
	p-value		NA	NA	0.952	0.828	NA
SNNP	Any/ some education	HAZ	-0.6242	-0.9918	-1.0489	-1.2544	NA
		Prev. <-2 HAZ	12.9%	22.6%	27.6%	35.0%	NA
		n (wtd/ un-wtd)	48/ 22	192/ 112	75/ 49	308/ 201	0/0
	No education	HAZ	-2.3700	-1.7885	-1.4462	-1.4501	-2.5181
		Prev. <-2 HAZ	100.0%	43.9%	33.1%	38.9%	56.7%

		n (wtd/ un-wtd)	3/ 1	151/ 101	116/ 75	762/ 507	2/ 2
		p-value	NA	0.000	0.069	0.068	NA
Gambela	Any/ some education	HAZ	-0.1325	-1.0166	-0.6504	-0.4461	0.2917
		Prev. <-2 HAZ	13.6%	24.3%	17.9%	17.6%	0.0%
		n (wtd/ un-wtd)	0/ 5	3/ 33	8/ 141	4/ 111	0/ 2
	No education	HAZ	-0.8848	-1.5387	-0.7814	-0.9862	NA
		Prev. <-2 HAZ	50.6%	37.0%	27.2%	23.5%	NA
		n (wtd/ un-wtd)	0/4	1/ 12	4/ 92	6/ 161	0/0
		p-value	NA	NA	0.897	0.652	NA
Harari	Any/ some education	HAZ	-0.5600	-0.9225	-0.7615	-0.7920	-0.5230
		Prev. <-2 HAZ	12.9%	19.1%	22.3%	31.7%	13.9%
		n (wtd/ un-wtd)	3/ 58	2/ 51	1/ 30	1/ 24	0/ 6
	No education	HAZ	-0.7417	-0.7159	-0.7683	-1.1717	-1.9886
		Prev. <-2 HAZ	6.1%	15.3%	18.3%	34.9%	56.6%
		n (wtd/ un-wtd)	1/ 13	2/ 51	3/ 73	4/ 97	0/ 11
		p-value	NA	0.914	0.998	NA	NA
Addis Ababa	Any/ some education	HAZ	-0.6431	-0.8976	NA	-1.3200	2.2600
		Prev. <-2 HAZ	13.4%	22.8%	NA	0.0%	0.0%
		n (wtd/ un-wtd)	77/ 155	51/ 79	0/ 0	1/ 1	1/ 1
	No education	HAZ	-0.3088	-1.3006	NA	NA	NA
		Prev. <-2 HAZ	26.1%	33.8%	NA	NA	NA
		n (wtd/ un-wtd)	14/ 26	18/ 27	0/0	0/0	0/0
		p-value	NA	NA	NA	NA	NA
Dire Dawa	Any/ some education	HAZ	-0.0465	-0.5535	NA	-0.8533	2.2400
		Prev. <-2 HAZ	7.7%	14.5%	NA	20.9%	0.0%
		n (wtd/ un-wtd)	3/ 47	3/ 53	0/0	1/ 26	0/ 1
	No education	HAZ	-0.9267	-1.3426	-1.2402	-1.4910	NA
		Prev. <-2 HAZ	22.2%	30.2%	28.4%	40.0%	NA
		n (wtd/ un-wtd)	1/ 21	7/ 124	1/ 21	8/ 167	0/0
		p-value	NA	0.480	NA	NA	NA
Total	Any/ some education	HAZ	-0.7464	-1.2518	-1.4678	-1.4490	-0.6466
		Prev. <-2 HAZ	18.4%	29.3%	40.5%	40.5%	24.7%
		n (wtd/ un-wtd)	306/ 435	791/ 625	318/ 483	1159/ 848	21/ 39
	No education	HAZ	-1.3335	-1.5368	-1.5739	-1.5504	-0.8248
		Prev. <-2 HAZ	41.2%	40.9%	40.1%	41.4%	32.0%
		n (wtd/ un-wtd)	95/ 127	1067/ 915	926/ 1266	3712/ 3121	65/ 115
		p-value	0.001	0.000	0.279	0.054	0.705

Mgood=1, weighted.

Table 2.30 Percent of total population within category of water source (well and surface/ rainwater together) and education, all ages, 2011.

Water	No education	Some education
Well + surface (unimproved)	55.3%	17.6%
Public tap or better (improved)	13.8%	13.1%

Mgood=1, weighted.

Table 2.31 Summary of regional analysis of the association of poor water supply with height-for-age, ages 24 months and older, 2011.

Dependent variable: HAZ; in cells: coefficient (t,p).

Region	Poor Water Supply	Interaction: Poor Water Supply * No Education
Tigray	-0.169 (-1.640, 0.102)	
Affar	-1.346 (-2.017, 0.044)	1.256 (1.815, 0.070)* ¹
Amhara	0.027 (0.233, 0.816)	
Oromiya	-0.220 (-2.240, 0.025)**	
Somali	0.258 (1.365, 0.173)	
Benishangul-Gumuz	-0.545 (-1.824, 0.069)	0.590 (1.762, 0.079)*
SNNP	-0.457 (-2.387, 0.017)	0.577 (2.369, 0.018)**
Gambela	-0.289 (-1.654, 0.099)*	
Harari	-0.198 (-0.922, 0.357)	
Addis Ababa ²		
Dire Dawa	-0.435 (-2.242, 0.026)**	

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: child age, child sex, poor water supply, no education, interaction of poor water supply and no education, and poor roofing.

** Indicates statistical significance at the 0.05 alpha level.

* Indicates statistical significance at the 0.10 alpha level.

¹The interaction of no education and poor water supply is significant in Affar at the 0.10 alpha level, however the sample size in one of the groups is inadequate at n=8 (poor drinking water source, educated). This can be seen in {SM WASH2 15}.

²Addis Ababa was not analyzed since only 1 child in the sample had a poor water supply, table 2.29.

Note: The interaction term of poor water supply and no education was removed from the model if it was not significant at the 0.10 alpha level.

2.C Risk factors: Poverty (assets) – Tables

Table 2.32 Hypothetical example of potential interaction with factor not included in poverty definition, with differential effects by wealth quintile, on stunting prevalences.

Group	Stunting prevalence		Total
	Remote (e.g. ≥ 6 hrs from service)	Not remote (e.g. < 6 hrs from service)	
Wealth quintile worse	70%	40%	55%
Wealth quintile better	60%	40%	50%
Total	65%	40%	53%

Note: Here remoteness is associated with a 30 ppt difference for the worse quintile, and only 20 ppts for the better one; this is more than

2.C Risk factors: IYCF – Tables

Table 2.33 Percent receiving: four or more foods, and three or more foods, among currently breastfeeding and non-breastfeeding children, ages 6 to 23 months, 2011.

	Four or more foods	Three or more foods	n
Currently breastfeeding	4.5%	16.6%	2349
Not currently breastfeeding	12.9%	31.1%	241
Total	5.3%	17.9%	2590

Mgood=1, un-weighted.

Table 2.34 Mean height-for-age by three+ foods category in 3-month age groups, ages 6 to 23 months, 2011.

Age Group	Three+ Foods			Less than three foods			Total Row N	p-value (HAZ)
	HAZ	Prevalence Stunting	N	HAZ	Prevalence Stunting	N		
6-8 months	0.0093	7.1%	42	-0.2879	10.2%	490	532	0.232
9-11 months	-0.8774	20.4%	54	-1.1893	29.4%	347	401	0.173
12-14 months	-0.9334	20.3%	74	-1.2704	33.5%	385	459	0.092 ^(*)
15-17 months	-1.4975	43.0%	107	-1.7748	46.7%	332	439	0.092 ^(*)
18-20 months	-1.5884	43.3%	90	-2.0777	50.9%	269	359	0.003**
21-23 months	-1.8698	45.5%	88	-2.2093	59.8%	209	297	0.061 ^(*)
Total (6-23 months)	-1.2831	33.9%	455	-1.3055	34.4%	2032	2487	0.791
24-36 months [†]	[-0.2896]	[8.3%]	24	-1.3526	31.9%	314	338	[0.001]

Mgood=1, un-weighted.

^(*) Significant at p=0.1; * significant at p=0.05; ** significant at p=0.01; *** significant at p=0.001.

[†] This group included only children with height measured standing.

[] Indicates too small of a sample size was used to calculate the statistic.

Table 2.35 The association of three or more foods, as a measure of dietary diversity, with height-for-age among breastfed and non-breastfed children together, ages 18 to 20 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age		-0.037 (-0.407, 0.684)	-0.042 (-0.473, 0.637)	-0.048 (-0.537, 0.592)	-0.049 (-0.553, 0.581)	-0.048 (-0.538, 0.591)	-0.059 (-0.644, 0.520)
Sex		0.010 (0.070, 0.944)	0.006 (0.040, 0.968)	0.011 (0.076, 0.940)	-0.003 (-0.019, 0.985)	-0.003 (-0.022, 0.983)	-0.019 (-0.131, 0.896)
Three + Foods		0.496 (3.001, 0.003)	-0.080 (-0.210, 0.834)	0.418 (2.527, 0.012)	0.359 (1.524, 0.128)	0.308 (1.844, 0.066)	0.307 (1.784, 0.075)
Currently Breastfeeding			-0.876 (-3.341, 0.001)	-0.642 (-3.114, 0.002)	-0.610 (-2.968, 0.003)	-0.618 (-3.033, 0.003)	-0.588 (-2.825, 0.005)
Interaction: Three+ Foods * Currently Breastfeeding			0.601 (1.440, 0.151)				
No Education					-0.437 (-2.556, 0.011)	-0.464 (-3.181, 0.002)	-0.403 (-2.668, 0.008)
Interaction: Three+ Foods *No Education					-0.103 (-0.308, 0.758)		
Poor Roofing							-0.396 (-2.694, 0.007)
Constant	-1.397	-0.507	-0.614	-0.314	-0.316	-0.316	0.082
Adj. R Square	0.017	0.043	0.040	0.062	0.064	0.064	0.083
N	359	359	359	359	359	359	340

Mgood=1, un-weighted.

Dependent variable: HAZ; in cells: coefficient (t, p).

Independent variables: age, sex, three+ foods, currently breastfeeding, interaction of three+ foods and currently breastfeeding, no education, interaction of no education and three+ foods, poor roofing.

Table 2.36 Percentage of children who received three or more foods in the previous 24 hours, among currently breastfed and non-breastfed children, by 3-month age groups, ages 6 to 23 months, 2011.

Age group	Currently breastfeeding		Not currently breastfeeding	
	Receiving three+ foods	n	Receiving three+ foods	n
6-8 months	7.95%	541	7.69%	13
9-11 months	13.22%	401	13.33%	15
12-14 months	16.10%	441	14.71%	34
15-17 months	22.69%	401	27.12%	59
18-20 months	22.01%	318	40.38%	52
21-23 months	24.70%	247	44.12%	68
Total	16.56%	2349	31.12%	241

Mgood=1, un-weighted.

Table 2.37 Mean height-for-age and prevalence of stunting by dietary diversity among non-breastfeeding children, in 6-month age groups, ages 6 to 36 months, 2011.

Age Group	Three+ Foods			Less than three foods			Total Row N	p-value (HAZ)
	HAZ	Prevalence Stunting	N	HAZ	Prevalence Stunting	N		
6-11 months	[-0.3300]	[0.0%]	3	[-0.5813]	[13.0%]	23	26	[0.812]
12-17 months	[-1.5495]	[42.9%]	21	-1.2746	37.7%	69	90	[0.565]
18-23 months	-1.5408	34.0%	50	-1.6182	38.5%	65	115	0.789
Total (6-23 months)	-1.4942	35.1%	74	-1.3153	34.4%	157	231	0.462
24-36 months	[-0.6550]	[16.7%]	6	-0.1523	15.4%	13	19	[0.559]

Mgood=1, un-weighted.

[] Indicates too small of a sample size was used to calculate the statistic.

Table 2.38 The association of three or more foods, as a measure of dietary diversity, with height-for-age among non-breastfeeding children, ages 6 to 23 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2
Age		-0.087 (-3.327, 0.001)
Sex		-0.017 (-0.076, 0.939)
Three + Foods	-0.179 (-0.736, 0.462)	0.045 (0.183, 0.855)
Constant	-1.315	0.128
Adj. R Square	-0.002	0.037
N	231	231

Mgood=1, un-weighted.

Dependent variable: HAZ

Independents variables: age, sex, three+ foods.

Table 2.39 Mean height-for-age and prevalence of stunting by dietary diversity among currently breastfeeding children in 3-month age group, ages 6 to 23 months, 2011.

Age Group	Three or more foods			Less than three foods			Total row n	p-value (HAZ)
	HAZ	Prevalence Stunting	n	HAZ	Prevalence Stunting	n		
6-8 months	-0.0161	7.3%	41	-0.2921	10.5%	478	519	0.275
9-11 months	-0.8719	21.2%	52	-1.1928	29.5%	336	388	0.165
12-14 months	-0.9180	21.7%	69	-1.2912	34.0%	356	425	0.067 ^(*)
15-17 months	-1.4662	40.7%	91	-1.8175	46.9%	292	383	0.037 [*]
18-20 months	-1.6480	46.4%	69	-2.1720	52.9%	240	309	0.004 ^{**}
21-23 months	-1.9788	50.9%	59	-2.2784	63.6%	173	232	0.147
Total (6-23 months)	-1.2420	33.6%	381	-1.3046	34.4%	1875	2256	0.492
24-36 months	[-0.1678]	[5.6%]	18	-1.4045	32.6%	301	319	[0.001]

Mgood=1, un-weighted.

^(*) Significant at p=0.1; ^{*} significant at p=0.05; ^{**} significant at p=0.01; ^{***} significant at p=0.001.

[] Indicates too small of a sample size was used to calculate the statistic.

Table 2.40 The association of dietary diversity, measured by three or more foods, with height-for-age among currently breastfeeding children, ages 6 to 23 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).										
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Age		-0.134 (-21.232, 0.000)	-0.134 (-21.256, 0.000)	-0.134 (-21.264, 0.000)	-0.131 (-20.505, 0.000)	-0.131 (-20.502, 0.000)	-0.131 (-20.512, 0.000)	-0.131 (-20.466, 0.000)	-0.131 (-20.480, 0.000)	-0.129 (-20.898, 0.000)
Sex		0.142 (2.273, 0.023)	0.141 (2.271, 0.023)	0.141 (2.274, 0.023)	0.110 (1.749, 0.080)	0.108 (1.711, 0.087)	0.109 (1.724, 0.085)	0.110 (1.746, 0.081)	0.110 (1.741, 0.082)	0.127 (2.086, 0.037)
Three + Foods	0.063 (0.687, 0.492)	0.352 (4.162, 0.000)	0.300 (2.426, 0.015)	0.272 (3.197, 0.001)	0.246 (2.887, 0.004)	0.292 (2.612, 0.009)	0.241 (2.826, 0.005)	0.312 (2.780, 0.005)	0.240 (2.807, 0.005)	0.232 (2.800, 0.005)
No Education			-0.347 (-4.648, 0.000)	-0.357 (-5.342, 0.000)	-0.311 (-4.552, 0.000)	-0.298 (-4.320, 0.000)	-0.298 (-4.325, 0.000)	-0.285 (-4.081, 0.000)	-0.287 (-4.112, 0.000)	-0.193 (-2.847, 0.004)
Interaction: Three+ Foods * No Education			-0.052 (-0.311, 0.756)							
Poor Roofing					-0.375 (-5.853, 0.000)	-0.362 (-5.622, 0.000)	-0.365 (-5.670, 0.000)	-0.349 (-5.326, 0.000)	-0.352 (-5.372, 0.000)	-0.378 (-5.974, 0.000)
No toilet						-0.070 (-1.002, 0.317)	-0.090 (-1.404, 0.160)	-0.083 (-1.281, 0.200)	-0.084 (-1.308, 0.191)	-0.157 (-2.509, 0.012)
Interaction: Three+ Foods * No Toilet						-0.119 (-0.707, 0.479)				
Poor Water Supply								-0.042 (-0.595, 0.552)	-0.070 (-1.062, 0.288)	-0.016 (-0.257, 0.797)
Interaction: Three+ Foods * Poor Water Supply								-0.167 (-0.996, 0.319)		
Mother's height										0.061 (12.664, 0.000)
Constant	-1.305	0.222	0.462	0.469	0.663	0.686	0.697	0.691	0.710	-8.906
Adj. R Square	0.000	0.168	0.178	0.178	0.186	0.186	0.186	0.186	0.186	0.244
N	2256	2256	2256	2256	2132	2132	2132	2132	2132	2122

Mgood=1, un-weighted.

Dependent variable: HAZ.

Independent variables: age, sex, three+ foods, no education, interaction of no education and three+ foods, poor roofing, no toilet, interaction of no toilet and three+ foods, poor water supply, and interaction of poor water supply and three+ foods.

Table 2.41 Summary of age group analyses: association of three or more foods, as a measure of dietary diversity, with height-for-age among currently breastfeeding children, ages 6 to 23 months, 2011.

Age Group	Coefficient (t, p) ¹	n
6 to 8 months	0.265 (1.049, 0.295)	488
9 to 11 months ²	0.138 (0.590, 0.555)	368
12 to 14 months	0.238 (1.135, 0.257)	405
15 to 17 months	0.251 (1.495, 0.136)	357
18 to 20 months	0.467 (2.556, 0.011)*	293
21 to 23 months	0.166 (0.768, 0.443)	221
Total (6 to 23 months)	0.246 (2.887, 0.004)**	2132

Mgood=1, un-weighted.

(*) Significant at p=0.1; * significant at p=0.05; ** significant at p=0.01; *** significant at p=0.001.

¹ Coefficient (t, p) of the variable three+ foods in the linear regression model with HAZ as the dependent variable and age, sex, no education and poor roofing included along with three+ foods as independent variables. See supplementary material (tables {SM IYCF1 A1-A7}) for detailed models.

² The 9 to 11 month analysis revealed a significant interactive effect between three+ foods and no education on the outcome HAZ, such that consuming less than three foods resulted in a significantly lower HAZ among the uneducated than the educated. The sample size of the uneducated, receiving three+ foods cell was small at n=19. The statistics of this interaction when controlling for roofing, no toilet, and water supply were: Coefficient (t, p) = 0.842 (1.755, 0.080). See supplementary material (tables {SM IYCF1 A2-A3}) for full model.

Table 2.42 Percentage of children receiving three or more food groups, by region, ages 6 to 23 months, 2011.

Region	Percent of children receiving three + foods.	N
Tigray	18.2%	281
Affar	7.1%	170
Amhara	11.7%	274
Oromiya	19.9%	397
Somali	4.6%	130
Benishangul-Gumuz	19.9%	216
SNNP	18.6%	350
Gambela	21.6%	176
Harari	17.7%	136
Addis Ababa	19.5%	82
Dire Dawa	16.8%	137
Total	16.6%	2349

Mgood=1, un-weighted.

Table 2.43 Regional groupings used to analyze the association of minimum dietary diversity with height-for-age at sub-national levels.

Initial groupings	Region	Secondary groupings
Group 1	Affar Somali	Group 1
Group 2	Oromiya SNNP Benishangul- Gumuz Gambela	Group 2
Group 3	Harari Dire Dawa	Group 3
Group 4	Amhara	
Group 5	Tigray	
Group 6	Addis Ababa	

Table 2.44 Mean height-for-age and prevalence of stunting, by dietary diversity category, among currently breastfeeding children by regional grouping, ages 6 to 23 months, 2011.

Region(s)	Three+ Foods			Less than three foods			Total Row n	p-value (HAZ)
	HAZ	Prevalence Stunting	n	HAZ	Prevalence Stunting	n		
Affar and Somali	[-1.0076]	[29.4%]	[17]	-1.1884	33.5%	263	280	[0.675]
Oromiya, SNNP, Benishangul- Gumuz, Gambela	-1.3096	35.3%	221	-1.2289	31.4%	876	1097	0.504
Harari, Dire Dawa	-0.5549	17.8%	45	-0.6922	17.7%	220	265	0.595
Amhara	-1.5591	37.5%	32	-1.9296	50.2%	227	259	0.190
Tigray	-1.8156	48.0%	50	-1.9227	51.5%	227	277	0.602
Addis Ababa	[-0.0644]	[6.3%]	[16]	-0.4900	17.7%	62	78	[0.376]
Total	-1.2420	33.6%	381	-1.3046	34.4%	1875	2256	0.492

Mgood=1, un-weighted.

[] Indicates too small of a sample size was used to calculate the statistic.

Table 2.45 Regional mean height-for-age by dietary diversity category among currently breastfeeding children, un-adjusted, and adjusted for child's age and gender, ages 6 to 23 months, 2011.

Region(s)	Adjusted Mean HAZ ¹		Un-Adjusted Mean HAZ	
	Three + foods	Less than three foods	Three + foods	Less than three foods
Affar and Somali	[-0.846]	-1.219	[-1.008]	-1.188
Oromiya, SNNP, Benishangul-Gumuz, Gambela	-1.080	-1.290	-1.310	-1.229
Harari, Dire Dawa	-0.310	-0.770	-0.555	-0.692
Amhara	-1.477	-1.950	-1.559	-1.9296
Tigray	-1.64848	-1.964	-1.816	-1.923
Addis Ababa	[0.467]	-0.581	[-0.064]	-0.490
Total	-0.999	-1.351	-1.242	-1.305

Mgood=1, un-weighted.

[] Indicates too small of a sample size was used too calculate the statistic.

¹ Adjusted using mean age and mean gender within each regional group.

Table 2.46 Summary of regional (grouping 1) analyses of the association of three or more foods with height-for-age among currently breastfeeding children, ages 6 to 23 months, 2011.

Dependent variable: HAZ.

Region(s)	Coefficient (t, p) ¹	n
Affar and Somali	-0.062 (-0.143, 0.887)	223
Oromiya, SNNP, Benishangul-Gumuz, Gambela	0.153 (1.345, 0.179)	1079
Harari, Dire Dawa	0.271 (1.127, 0.261)	247
Amhara	0.482 (1.755, 0.080 ^(*))	247
Tigray	0.267 (1.370, 0.172)	258
Addis Ababa	[1.074 (2.447, 0.017)]	77
Total	0.246 (2.887, 0.004 ^{***})	2132

Mgood=1, un-weighted.

(^(*)) Significant at p=0.1; * significant at p=0.05; ** significant at p=0.01; *** significant at p=0.001.

[] Indicates too small of a sample size was used too calculate the statistic.

¹ Coefficient (t, p) of the variable three+ foods in the linear regression model with HAZ as the dependent variable and age, sex, no education and poor roofing included along with three+ foods as independent variables. See supplementary material (tables {SM IYCF1 A8-A13}) for detailed models.

Table 2.47 Summary of regional (grouping 2) analyses of the association of dietary diversity with height-for-age among currently breastfeeding children, ages 6 to 23 months, 2011.

Dependent variable: HAZ.

Region(s)	Coefficient (t, p)¹	n
Affar and Somali	-0.062 (-0.143, 0.887)	223
Oromiya, SNNP, Benishangul-Gumuz, Gambela	0.153 (1.345, 0.179)	1079
Harari, Dire Dawa, Amhara, Tigray, Addis Ababa	0.388 (2.918, 0.004) **	829
Total	0.246 (2.887, 0.004 **)	2132

Mgood=1, un-weighted.

(*) Significant at p=0.1; * significant at p=0.05; ** significant at p=0.01; *** significant at p=0.001.

¹ Coefficient (t, p) of the variable three+ foods in the linear regression model with HAZ as the dependent variable and age, sex, no education and poor roofing included along with three+ foods as independent variables. See supplementary material (tables {SM IYCF1 A8-A14}) for detailed model.

Child Stunting and Infant and Young Child feeding Practices in Ethiopia: EDHS 2000, 2005 and 2011.

Table 2.48 Summary of associations of select IYCF practices with height-for-age at different ages, 2011.

In cells: weighted percent achieving the IYCF practice; weighted, un-adjusted effect size; un-weighted, un-adjusted effect size; un-weighted, adjusted effect size.

Age in months		0 to 2	3 to 5	6 to 8	9 to 11	12 to 14	15 to 17	18 to 20	21 to 23
Early initiation of breastfeeding	Weighted %	47.8%	49.6%	57.4%	56.4%	53.2%			
	Un-adjusted effect size: weighted	0.59***	0.18 (NS)	-0.07 (NS)	-0.10 (NS)	-0.04 (NS)			
	Un-adjusted Effect size: un-weighted	0.36*	0.16 (NS)						
	Adjusted Effect size: un-weighted	0.22 ^a (p=.195)	0.12 ^b (NS)						
Age in months		0 to 2	3 to 5	6 to 8	9 to 11	12 to 14	15 to 17	18 to 20	21 to 23
Exclusive breastfeeding under 6 months	Weighted %	64.7%	38.8%	16.9%					
	Un-adjusted effect size: weighted	-0.61***	-0.36 (NS)	-0.35 (p=.051)					
	Un-adjusted Effect size: un-weighted	-0.40***							
	Adjusted Effect size: un-weighted	-0.40***							
Age in months		0 to 2	3 to 5	6 to 8	9 to 11	12 to 14	15 to 17	18 to 20	21 to 23
Consumption of solid, semi-solid or soft foods	Weighted %		17.6%	48.5%	76.2%	81.6%			
	Un-adjusted effect size: weighted		-0.24 (p=.142)	0.53***	0.47**	-0.18 (NS)			
	Un-adjusted effect size: un-weighted		0.08 (NS)	0.38**	0.43*	0.01 (NS)			
	Adjusted effect size: un-weighted		0.20 ^c (NS)	0.48 ^d ***	0.37 ^e .*	-0.01 (NS)			
Age in months		0 to 2	3 to 5	6 to 8	9 to 11	12 to 14	15 to 17	18 to 20	21 to 23
Minimum meal frequency	Weighted %			36.3%	41.7%	45.4%	53.1%	65.2%	72.6%
	Un-adjusted effect size: weighted			0.49***	0.40**	0.04 (NS)	0.23 (p=.120)	0.09 (NS)	-0.22 (NS)
	Un-adjusted Effect size: un-weighted			0.32*	0.34*	0.22 (p=.156)	0.00 (NS)		
	Adjusted Effect size: un-weighted			0.35 ^f .*	0.33*	0.20 (p=.184)			

Age in months		0 to 2	3 to 5	6 to 8	9 to 11	12 to 14	15 to 17	18 to 20	21 to 23
Minimum dietary diversity (breastfeeding children only)	Weighted			9.1%	11.4%	16.4%	22.8%	22.5%	24.9%
	Un-adjusted effect size: weighted			0.30 (p=.185)	0.42*	0.16 (NS)	0.33*	0.01 (NS)	0.37*
	Un-adjusted Effect size: un-weighted			0.21 (NS)	0.34 (p=.143)	0.34 (p=.097)	0.30 (p=.091)	0.49**	0.30 (p=.147)
	Adjusted Effect size: un-weighted			0.025 (NS)	0.21 ^g (NS)	0.27 (p=.199)	0.30 (p=.070)	0.32 (p=.059)	0.12 (NS)

Mgood=1, weighted/un-weighted as indicated.

Levels of significance: *p<=0.05, **p<=0.01, ***p<=0.001, NS indicates p>=0.2; exact p-values given if 0.05<p<0.2.

- There is an interactive effect on HAZ between *early initiation of breastfeeding and age* in 0 to 2 month olds, which is not reflected in the given coefficient.
- There is a significant interactive effect on HAZ between *early initiation of breastfeeding and age* in 3 to 5 month olds, which is not reflected in the given coefficient.
- There is a significant interactive effect on HAZ between *consumption of SSS foods and age* in 3 to 5 month olds that remains when controlling for roofing and education, but diminishes when mother's height is added to the model. This interaction is not reflected in the coefficient given here.
- There is a significant interactive effect on HAZ between *consumption of SSS foods and education* in 6 to 8 month olds that remains significant when controlling for age, gender, roofing, and mothers height. This interaction is not reflected in the coefficient given.
- There is a significant interactive effect on HAZ between *consumption of SSS foods and education* in 9 to 11 month olds that remains when controlling for age, gender, roofing and mother's height. This interaction is not reflected in the coefficient given.
- There is a significant interactive effect on HAZ between *minimum meal frequency and education* in 6 to 8 month olds that remains when controlling for age, gender, roofing and mother's height. This interaction is not reflected in the coefficient given.
- There is an interactive effect on HAZ between *minimum dietary diversity and education* in 9 to 11 month old children, but the association is weak (p=0.118 with age, gender, roofing and mother's height in the model). This interaction is not reflected in the given coefficient.

Early initiation of breastfeeding

Table 2.49 Early initiation of breastfeeding trends: percent of children born in the last 24 months put to the breast within one hour of birth by survey, age groups (0 to 23 months), and region.

In cells: weighted % (weighted n/ un-weighted n).

Age group	2000	2005	2011
0 to 2 months	51.6% (519/ 459)	63.5% (277/ 225)	47.8% (607/ 561)
3 to 5 months	46.0% (544/ 505)	64.2% (299/ 271)	49.6% (641/ 624)
6 to 8 months	53.2% (562/ 512)	66.4% (274/ 239)	57.4% (613/ 592)
9 to 11 months	47.9% (532/ 423)	73.8% (225/ 203)	56.4% (498/ 437)
0 to 11 months	49.7% (2156/ 1899)	66.6% (1077/ 938)	52.6% (2358/ 2214)
12 to 23 months	48.1% (2070/ 1784)	68.3% (915/ 859)	53.2% (1894/ 1872)
0 to 23 months	48.9% (4227/ 3683)	67.4% (1992/ 1797)	52.9% (4252/ 4086)***
Region (0 to 23 months)			
Tigray	28.3% (251/ 360)	46.4% (125/ 173)	46.4% (261/ 414)***
Affar	31.4% (35/ 178)	87.0% (23/ 128)	61.1% (36/ 353)*
Amhara	29.8% (1092/ 548)	58.1% (456/ 252)	38.1% (928/ 448)***
Oromiya	60.3% (1729/ 760)	68.3% (758/ 334)	53.4% (1850/ 655)***
Somali	53.5% (43/ 202)	97.4% (78/ 107)	42.3% (123/ 350)
Benishangul-Gumuz	47.6% (42/ 276)	68.4% (19/ 135)	43.8% (48/ 356)
SNNP	56.0% (931/ 567)	73.9% (486/ 335)	69.0% (880/ 572)***
Gambela	50.0% (10/ 212)	80.0% (5/ 90)	61.5% (13/ 299)
Harari	66.7% (9/ 192)	80.0% (5/ 106)	70.0% (10/ 234)
Addis Ababa	50.0% (68/ 189)	66.7% (30/ 67)	67.4% (86/ 154)*
Dire Dawa	50.0% (14/ 199)	85.7% (7/ 70)	66.7% (15/ 251)

Mgood=1 or 0; weighted percentages given.

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: * p<=0.05,

** p<=0.01, *** p<=0.001

Table 2.50 Mean height-for-age by early initiation of breastfeeding, 3-month age group (0 to 14 months), and survey year.

In cells: weighted mean HAZ (weighted n/ un-weighted n); total n (weighted/ un-weighted).

Age group	2000	2005	2011
0 to 2 months			
Put to breast w/in 1 hr. of birth	-0.6885 (226/ 179)	0.3076* (93/77)	0.2146*** (225/239)
Not put to breast w/in 1 hr. of birth	-0.4669 (198/ 197)	-0.4674 (73/47)	-0.3767 (240/193)
N (weighted/ un-weighted)	423/ 376	166/ 124	465/ 432
3 to 5 months			
Put to breast w/in 1 hr. of birth	-0.7294 (237/219)	-0.4662 (148/136)	-0.0544 (291/276)
Not put to breast w/in 1 hr. of birth	-0.8154 (267/252)	-0.5682 (91/76)	-0.2366 (285/269)
N (weighted/ un-weighted)	503/ 471	239/ 212	576/ 545
6 to 8 months			
Put to breast w/in 1 hr. of birth	-1.1198 (266/237)	-1.0234 (154/140)	-0.3583 (315/301)
Not put to breast w/in 1 hr. of birth	-1.1010 (243/234)	-1.1579 (83/57)	-0.4165 (234/236)
N (weighted/ un-weighted)	509/ 471	237/ 197	549/ 537
9 to 11 months			
Put to breast w/in 1 hr. of birth	-1.5630 (245/192)	-1.3085 (144/130)	-1.3527 (268/222)
Not put to breast w/in 1 hr. of birth	-1.7984 (253/202)	-1.1344 (54/47)	-1.2511 (201/177)
N (weighted/ un-weighted)	497/ 394	197/ 177	469/ 399
12 to 14 months			
Put to breast w/in 1 hr. of birth	-2.0085* (230/205)	-1.6069 (143/134)	-1.3680 (263/258)
Not put to breast w/in 1 hr. of birth	-1.6715 (258/213)	-1.4416 (83/65)	-1.3279 (228/204)
N (weighted/ un-weighted)	488/ 418	226/ 199	491/ 462

Mgood=1, weighted.

* Indicate p-value significance compared with cell below; levels of significance: * p<=0.05, ** p<=0.01,

*** p<=0.001

Table 2.51 The association of early initiation of breastfeeding with height-for-age, ages 0 to 2 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Age		0.118 (1.016, 0.310)	0.426 (2.442, 0.015)	0.398 (2.156, 0.032)	0.378 (2.107, 0.036)	0.373 (2.080, 0.038)	0.343 (1.934, 0.054)	0.099 (0.854, 0.394)
Sex		0.054 (0.320, 0.749)	0.056 (0.331, 0.741)	0.056 (0.323, 0.747)	0.078 (0.454, 0.650)	0.083 (0.485, 0.628)	0.060 (0.359, 0.720)	0.058 (0.344, 0.731)
Early initiation of breastfeeding	0.360 (2.131, 0.034)	0.364 (2.153, 0.032)	1.061 (3.117, 0.002)	0.949 (2.723, 0.007)	1.062 (2.499, 0.013)	0.893 (2.576, 0.010)	0.761 (2.223, 0.027)	0.221 (1.297, 0.195)
Interaction: Early initiation of BF * Age			-0.547 (-2.355, 0.019)	-0.484 (-2.027, 0.043)	-0.466 (-1.966, 0.050)	-0.461 (-1.944, 0.053)	-0.424 (-1.817, 0.070)	
Poor Roofing				-0.005 (-0.031, 0.975)	0.032 (0.183, 0.855)	0.036 (0.204, 0.839)	-0.015 (-0.086, 0.931)	-0.011 (-0.062, 0.951)
No Education					-0.338 (-1.222, 0.222)	-0.484 (-2.702, 0.007)	-0.395 (-2.226, 0.027)	-0.408 (-2.297, 0.022)
Interaction: Early initiation of BF * No Education					-0.249 (-0.688, 0.492)			
Mother's height							0.058 (4.275, 0.000)	0.058 (4.270, 0.000)
Constant	-0.105	-0.337	-0.735	-0.646	-0.460	-0.364	-9.396	-9.091
Adj. R Square	0.008	0.006	0.017	0.009	0.023	0.024	0.062	0.057
N	432	432	432	416	416	416	415	415

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, early initiation of breastfeeding, interaction of early initiation of breastfeeding and age, poor roofing, no education, interaction of early initiation of breastfeeding and no education, mother's height.

Table 2.52 The association of early initiation of breastfeeding with height-for-age, ages 3 to 5 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Age		-0.110 (-1.240, 0.215)	0.194 (1.497, 0.135)	0.188 (1.433, 0.152)	0.188 (1.436, 0.152)	0.187 (1.429, 0.154)	0.156 (1.224, 0.222)	-0.099 (-1.085, 0.278)
Sex		0.100 (0.717, 0.474)	0.087 (0.626, 0.532)	0.109 (0.763, 0.446)	0.111 (0.782, 0.435)	0.111 (0.781, 0.435)	0.100 (0.723, 0.470)	0.122 (0.848, 0.397)
Early initiation of breastfeeding	0.160 (1.144, 0.253)	0.162 (1.154, 0.249)	2.364 (3.369, 0.001)	2.265 (3.144, 0.002)	2.021 (2.719, 0.007)	2.242 (3.118, 0.002)	1.918 (2.736, 0.006)	0.122 (0.849, 0.396)
Interaction: Early initiation of BF * Age			-0.565 (-3.202, 0.001)	-0.550 (-3.036, 0.003)	-0.548 (-3.031, 0.003)	-0.544 (-3.008, 0.003)	-0.473 (-2.683, 0.008)	
Poor Roofing				-0.301 (-2.109, 0.035)	-0.274 (-1.906, 0.057)	-0.266 (-1.848, 0.065)	-0.288 (-2.059, 0.040)	-0.242 (-1.671, 0.095)
No Education					-0.444 (-2.073, 0.039)	-0.268 (-1.759, 0.079)	-0.242 (-1.640, 0.102)	-0.277 (-1.802, 0.072)
Interaction: Early initiation of BF * No Education					0.353 (1.169, 0.243)			
Mother's height							0.068 (6.254, 0.000)	
Constant	-0.107	0.171	-0.983	-0.824	-0.545	-0.664	-11.258	0.422
Adj. R Square	0.001	0.001	0.017	0.020	0.025	0.024	0.091	0.009
N	545	545	545	524	524	524	519	524

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, early initiation of breastfeeding, interaction of early initiation of breastfeeding and age, poor roofing, no education, interaction of early initiation of breastfeeding and no education, mother's height.

Table 2.53 Adjusted mean height-for-age by category of early initiation of breastfeeding and age (0 to 5 months), 2011.

In cells: un-weighted adjusted mean HAZ (un-weighted n), difference between groups, p-value.

Age in months	Early initiation of breastfeeding		Difference	p-value
	No	Yes		
0	-0.464 (28)	0.252 (40)	0.716	0.158
1	-0.160 (75)	0.371 (92)	0.531	0.054 ^(*)
2	0.242 (79)	0.121 (101)	-0.121	0.608
3	-0.193 (95)	0.324 (94)	0.517	0.026 [*]
4	-0.108 (102)	-0.058 (91)	0.005	0.825
5	0.159 (62)	-0.325 (75)	-0.484	0.068 ^(*)

Mgood=1, un-weighted.

(*) p<=0.1, * p<=0.05, ** p<=0.01, *** p<=0.001.

HAZ adjusted for covariates gender, roofing, education and mother's height within each age as follows:

0: gender=1.54, roofing=0.68, education=0.6471, mother's height in cm=158.60.

1: gender=1.47, roofing=0.62, education=0.6647, mother's height in cm=156.97.

2: gender=1.43, roofing=0.55, education=0.6222, mother's height in cm=157.80.

3: gender=1.49, roofing=0.52, education=0.6772, mother's height in cm=157.15.

4: gender=1.50, roofing=0.51, education=0.6269, mother's height in cm=157.64.

5: gender=1.49, roofing=0.55, education=0.7080, mother's height in cm=157.32.

Table 2.54 Exclusive breastfeeding under six months: percent of children 0 to 5 months fed exclusively breastmilk the 24 hours preceding the survey, 2000 and 2011.

In cells: weighted % (weighted n/ un-weighted n).

Age group	2000	2011
0 to 1 months	78.3% (332/ 290)	68.8% (378/ 344)**
2 to 3 months	48.6% (385/ 343)	54.8% (478/ 458)*
0 to 3 months	62.3% (716/ 633)	61.0% (856/ 802)
4 to 5 months	38.0% (363/ 344)	31.4% (405/ 402)*
0 to 5 months	54.2% (1078/ 977)	51.4% (1262/ 1204)
Region (0 to 5 months)		
Tigray	62.3% (69/ 99)	58.1% (62/ 102)
Affar	20.0% (10/ 50)	21.4% (14/ 124)
Amhara	70.5% (281/ 136)	71.6% (257/ 119)
Oromiya	54.7% (422/ 181)	46.1% (583/ 203)**
Somali	0.0% (13/ 54)	20.0% (45/ 122)
Benishangul-Gumuz	50.0% (14/ 93)	42.9% (14/ 105)
SNNP	40.8% (240/ 149)	51.2% (254/ 165)*
Gambela	0.0% (2/ 52)	25.0% (4/ 98)
Harari	0.0% (2/ 52)	50.0% (2/ 54)
Addis Ababa	15.0% (20/ 56)	34.8% (23/ 40)
Dire Dawa	25.0% (4/ 55)	50.0% (4/ 72)

Mgood=1 or 0, weighted.

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: *p<=0.05,

p<=0.01, *p<=0.001

Table 2.55 Mean height-for-age by exclusive breastfeeding status and 3-month age group (0 to 11 months), 2000, 2005, and 2011.

In cell: weighted mean HAZ; weighted/ un-weighted n.

Age group	2000	2005	2011
0 to 2 months			
Exclusively breastfeeding	-0.6903 (278/211)	-0.4130*** (107/66)	-0.3151*** (295/242)
Non-exclusively breastfeeding	-0.3833 (149/167)	0.7434 (63/61)	0.2976 (170/193)
N (weighted/ un-weighted)	427/378	170/127	465/435
3 to 5 months			
Exclusively breastfeeding	-0.7696 (216/147)	-0.7363 (78/57)	-0.0404 (226/165)
Non-exclusively breastfeeding	-0.8280 (297/329)	-0.3951 (161/156)	-0.1874 (357/388)
N (weighted/ un-weighted)	512/476	239/213	583/553
6 to 8 months			
Exclusively breastfeeding	-1.3716 (71/43)	-1.8494*** (34/22)	-0.6832 (84/60)
Non-exclusively breastfeeding	-1.0837 (449/435)	-0.9235 (204/177)	-0.3344 (467/481)
N (weighted/ un-weighted)	520/478	238/199	551/541
9 to 11 months			
Exclusively breastfeeding	-1.7415 (25/19)	-0.5186 (6/8)	-3.2558*** (14/11)
Non-exclusively breastfeeding	-1.6932 (474/377)	-1.2830 (192/170)	-1.2481 (456/392)
N (weighted/ un-weighted)	500/396	197/178	471/403

Mgood=1, weighted.

* Indicate p-values, compared with cell below; levels of significance: *p<=0.05, **p<=0.01, ***p<=0.001.

Table 2.56 Bivariate correlations of exclusive breastfeeding with height-for-age by 3-month age groups (0 to 11 months) and survey year.

Survey		0 to 2 months	3 to 5 months	6 to 8 months	9 to 11 months
2000	Pearson Correlation	-0.160**	-0.062	-0.088	-0.019
	p-value	0.002	0.180	0.055	0.708
	n	378	476	479	396
2005	Pearson Correlation	-0.170	-0.115	-0.229***	-0.021
	p-value	0.057	0.093	0.001	0.785
	n	127	213	199	178
2011	Pearson Correlation	-0.167***	-0.094*	-0.130**	-0.141
	p-value	0.000	0.027	0.003	0.005**
	n	435	553	541	403

Mgood=1, un-weighted.

Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.57 Continued breastfeeding at 1 year: percent of children ages 12 to 15 months who were breastfed during the previous 24 hours, by age group, region, and survey year.

In cells: weighted % (weighted n/ un-weighted n).

Age group	2000	2005	2011
6 to 8 months	99.3% (572/ 520)	97.8% (276/ 241)	98.4% (616/ 597)
9 to 11 months	98.1% (534/ 425)	97.8% (226/ 204)	95.8% (502/ 442)*
12 to 15 months	94.9% (780/ 680)	94.7% (377/ 358)	96.4% (695/ 689)
Region (12 to 15 months)			
Tigray	95.6% (45/ 64)	100.0% (22/ 32)	92.9% (42/ 66)
Affar	77.8% (9/ 44)	100.0% (5/ 30)	75.0% (8/ 79)
Amhara	99.0% (195/ 100)	97.6% (84/ 47)	98.8% (172/ 82)
Oromiya	92.8% (333/ 149)	92.1% (140/ 63)	97.8% (275/ 101)**
Somali	55.6% (9/ 42)	88.9% (18/ 24)	76.2% (21/ 61)
Benishangul-Gumuz	100.0% (7/ 44)	100.0% (4/ 31)	100.0% (8/ 61)
SNNP	98.2% (166/ 100)	96.9% (96/ 64)	96.6% (147/ 96)
Gambela	100.0% (2/ 44)	100.0% (1/ 20)	100.0% (2/ 44)
Harari	100.0% (2/ 40)	100.0% (1/ 24)	100.0% (1/ 37)
Addis Ababa	75.0% (12/ 31)	75.0% (4/ 12)	87.5% (16/ 30)
Dire Dawa	100.0% (1/ 22)	100.0% (1/ 11)	100.0% (2/ 32)

Mgood=1 or 0, weighted.

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: * p<=0.05,

** p<=0.01, *** p<=0.001

Table 2.59 Introduction of solid, semi-solid and soft foods: percent of children who received solid, semi-solid or soft foods yesterday by 3-month age group (3 to 14 months), region, and survey year.

In cells: weighted % (weighted n/ un-weighted n)

Age group	2000	2005	2011
3 to 5 months	8.5% (554/ 510)	20.5% (298/ 271)	17.6% (649/ 634)***
6 to 8 months	36.1% (568/ 517)	54.5% (275/ 241)	48.5% (616/ 596)***
9 to 11 months	73.7% (533/ 423)	81.9% (226/ 204)	76.2% (501/ 441)
12 to 14 months	86.1% (567/ 493)	88.0% (292/ 279)	81.6% (543/ 525)*
Region (6 to 8 months)			
Tigray	41.9% (31/ 46)	54.5% (11/ 15)	45.9% (37/ 55)
Affar	16.7% (6/ 32)	50.0% (2/ 15)	25.0% (4/ 39)
Amhara	27.7% (141/ 71)	49.1% (53/ 28)	36.9% (111/ 52)
Oromiya	31.7% (221/ 97)	54.9% (122/ 54)	57.2% (269/ 97)***
Somali	28.6% (7/ 37)	50.0% (10/ 14)	22.7% (22/ 63)
Benishangul-Gumuz	50.0% (6/ 44)	100.0% (1/ 15)	66.7% (6/ 45)
SNNP	47.2% (142/ 84)	58.6% (70/ 47)	43.7% (142/ 93)
Gambela	0.0% (1/ 36)	--- (0/ 13)	50.0% (2/ 33)
Harari	100.0% (1/ 21)	100.0% (1/20)	50.0% (2/ 47)
Addis Ababa	87.5% (8/ 21)	66.7% (3/ 6)	66.7% (18/ 29)
Dire Dawa	50.0% (2/ 28)	0.0% (1/ 14)	33.3% (3/ 43)

Mgood=1 or 0, weighted.

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: * p<=0.05,

** p<=0.01, *** p<=0.001

Table 2.60 Mean height-for-age by introduction of solid, semi-solid or soft foods, by 3-month age group (3 to 17 months), and survey year.

In cell: weighted mean HAZ (weighted/ un-weighted n in cell); weighted/ un-weighted n.

	2000	2005	2011
3 to 5 months			
Receiving SSS foods	-0.8338 (42/ 44)	-0.4362 (49/ 45)	-0.3282 (105/ 75)
Not receiving SSS foods	-0.8033 (470/ 431)	-0.5345 (188/ 167)	-0.0872 (479/ 477)
N weighted/ un-weighted	512/ 475	237/ 212	583/ 552
6 to 8 months			
Receiving SSS foods	-1.0380 (182/183)	-0.6363*** (129/107)	-0.1264*** (278/247)
Not receiving SSS foods	-1.1627 (335/294)	-1.5501 (109/92)	-0.6535 (274/293)
N weighted/ un-weighted	517/ 477	238/ 199	551/ 540
9 to 11 months			
Receiving SSS foods	-1.5810* (365/ 278)	-1.2390 (160/ 133)	-1.1968** (359/ 289)
Not receiving SSS foods	-1.9633 (133/ 117)	-1.35787 (37/ 45)	-1.6717 (112/ 114)
N weighted/ un-weighted	498/ 395	197/ 178	471/ 403
12 to 14 months			
Receiving SSS foods	-1.7349*** (419/ 349)	-1.4601* (199/ 174)	-1.3811 (406/ 355)
Not receiving SSS foods	-2.4316 (71/ 73)	-2.1700 (27/ 26)	-1.2021 (86/ 109)
N weighted/ un-weighted	490/ 422	226/ 200	492/ 464
15 to 17 months			
Receiving SSS foods	-2.2852*** (386/ 341)	-1.9734 (161/ 133)	-1.5643* (347/ 368)
Not receiving SSS foods	-3.0279 (42/ 49)	-1.7484 (11/ 16)	-2.0373 (46/ 77)
N weighted/ un-weighted	427/ 390	171/ 149	393/ 445

Mgood=1, weighted.

* Indicate p-value's compared with cell below; levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001

Table 2.61 The association of consumption of soild, semi-solid, or soft foods with height-for-age, ages 6 to 8 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Age		-0.268 (-3.326, 0.001)	-0.178 (-1.603, 0.109)	-0.257 (-3.089, 0.002)	-0.249 (-3.021, 0.003)	-0.237 (-2.991, 0.003)	-0.242 (-3.021, 0.003)	
Sex		0.037 (0.281, 0.779)	0.055 (0.411, 0.681)	0.022 (0.161, 0.872)	0.041 (0.310, 0.757)	0.103 (0.800, 0.424)	0.075 (0.579, 0.563)	
Any SSS foods	0.377 (2.803, 0.005)	0.503 (3.616, 0.000)	1.940 (1.638, 0.102)	0.475 (3.395, 0.001)	-0.230 (-0.921, 0.358)	-0.219 (-0.913, 0.362)	0.479 (3.429, 0.001)	
Interaction: Any SSS * Age			-0.205 (-1.222, 0.222)					
Poor Roofing				-0.315 (-2.358, 0.019)	-0.329 (-2.447, 0.015)	-0.311 (-2.401, 0.017)	-0.271 (-2.081, 0.038)	
No Education					-0.711 (-3.220, 0.001)	-0.659 (-3.095, 0.002)	-0.102 (-0.704, 0.482)	
Interaction: Any SSS * No Education					0.961 (3.233, 0.001)	1.018 (3.549, 0.000)		
Mother's height						0.066 (6.541, 0.000)	0.065 (6.346, 0.000)	
Constant	-0.413	1.338	0.703	1.460	1.947	-8.662	-8.841	
Adj. R Square	0.013	0.028	0.029	0.034	0.052	0.123	0.103	
N	540	540	540	527	527	526	526	

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, any SSS foods, interaction of any SSS foods and age, poor roofing, no education, interaction of any SSS foods and no education, mother's height.

Table 2.62 Interaction: Adjusted mean height-for-age by category of consumption of any solid, semi-solid or soft foods and education status in 6 to 8 month olds, 2011.

In cells: un-weighted adjusted mean HAZ (un-weighted n), difference in HAZ.

Education	Consumption of any solid, semi-solid, or soft foods		Difference	p-value
	No	Yes		
No Education	-0.603 (227)	0.196 (132)	0.799	0.000***
Any Education	0.056 (60)	-0.163 (107)	-0.219	0.361
p-value	0.002**	0.066(*)		

Mgood=1, un-weighted.

HAZ adjusted for covariates: age=6.97, gender=1.52, roofing=0.51, and mother's height=157.59.

(*) p<=0.1, * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.63 The association of consumption of solid, semi-solid, or soft foods with height-for-age, ages 9 to 11 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age		-0.327 (-3.488, 0.001)	-0.147 (-0.799, 0.425)	-0.318 (-3.378, 0.001)	-0.313 (-3.350, 0.001)	-0.287 (-3.107, 0.002)	-0.279 (-3.010, 0.003)
Sex		0.047 (0.309, 0.757)	0.036 (0.234, 0.815)	0.073 (0.475, 0.635)	0.103 (0.671, 0.503)	0.122 (0.810, 0.419)	0.111 (0.732, 0.465)
Any SSS foods	0.433 (2.510, 0.012)	0.500 (2.920, 0.004)	2.917 (1.377, 0.169)	0.444 (2.570, 0.011)	-0.247 (-0.788, 0.431)	-0.190 (-0.616, 0.538)	0.369 (2.165, 0.031)
Interaction: Any SSS * Age			-0.245 (-1.144, 0.253)				
Poor Roofing				-0.195 (-1.250, 0.212)	-0.167 (-1.074, 0.284)	-0.176 (-1.150, 0.251)	-0.172 (-1.117, 0.265)
No Education					-1.012 (-3.105, 0.002)	-0.853 (-2.644, 0.009)	-0.244 (-1.516, 0.130)
Interaction: Any SSS * No Education					0.932 (2.490, 0.013)	0.802 (2.174, 0.030)	
Mother's height						0.052 (4.011, 0.000)	0.054 (4.195, 0.000)
Constant	-1.464	1.681	-0.076	1.705	2.338	-6.176	-7.062
Adj. R Square	0.013	0.038	0.038	0.035	0.054	0.089	0.080
N	403	403	403	396	396	395	395

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, any SSS foods, interaction of any SSS foods and age, poor roofing, no education, interaction of any SSS foods and no education, mother's height.

Table 2.64 Interaction: Adjusted mean height-for-age by category of consumption of any solid, semi-solid or soft foods and education status in 9 to 11 month olds, 2011.

In cells: un-weighted adjusted mean HAZ (un-weighted n), difference in HAZ, p-values.

Education	Consumption of any solid, semi-solid, or soft foods		Difference	p-value
	No	Yes		
No Education	-1.665 (81)	-1.053 (173)	0.612	0.003**
Any Education	-0.813 (30)	-1.002 (111)	-0.189	0.541
p-value	0.009**	0.780		

Mgood=1, un-weighted.

HAZ adjusted for covariates: age=9.97, gender=1.50, roofing=0.56, and mother's height=156.35.

(*) p<=0.1, * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.65 Minimum meal frequency: percent of children ages 6 to 23 months who were fed solid, semi-solid or soft foods the minimum number of times as recommended per age and breastfeeding status, by 3-month age group, region, and survey year.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
6 to 8 months	21.1% (570/ 518)	81.6% (141/ 116)	36.3% (603/ 581)***
9 to 11 months	25.5% (530/ 421)	50.6% (178/ 143)	41.7% (480/ 426)***
12 to 14 months	47.2% (568/ 493)	64.3% (235/ 208)	45.4% (522/ 503)
15 to 17 months	51.6% (533/ 478)	59.6% (218/ 176)	53.1% (446/ 506)
18 to 20 months	62.2% (498/ 435)	61.2% (165/ 148)	65.2% (431/ 403)
21 to 23 months	66.2% (523/ 408)	67.1% (140/ 130)	72.6% (380/ 343)*
6 to 23 months	45.1% (3222/ 2753)	63.1% (1077/ 921)	50.6% (2863/ 2762)***
Region (6 to 23 months)			
Tigray	43.3% (187/ 267)	61.3% (62/ 88)	58.2% (196/ 308)**
Affar	38.5% (26/ 133)	62.5% (8/ 45)	26.1% (23/ 220)
Amhara	45.2% (814/ 413)	63.2% (220/ 119)	37.1% (615/ 301)***
Oromiya	49.2% (1348/ 597)	62.4% (431/ 190)	58.1% (1221/ 437)***
Somali	44.1% (34/ 157)	64.1% (39/ 50)	15.1% (73/ 211)**
Benishangul-Gumuz	53.3% (30/ 187)	55.6% (9/ 69)	48.5% (33/ 239)
SNNP	36.9% (712/ 429)	63.7% (281/ 194)	52.0% (610/ 397)***
Gambela	37.5% (8/ 158)	50.0% (2/ 41)	33.3% (9/ 193)
Harari	57.1% (7/ 140)	66.7% (3/ 60)	50.0% (8/ 171)
Addis Ababa	54.3% (46/ 130)	78.9% (19/ 45)	55.4% (65/ 116)
Dire Dawa	54.5% (11/ 142)	100.0% (1/ 20)	60.0% (10/ 169)

Mgood=0 or 1, weighted; Using variable "MinFreq3".

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: * p<=0.05, ** p<=0.01,

*** p<=0.001

Table 2.66 Mean height-for-age by minimum meal frequency status, 3-month age group (6 to 23 months), and survey year.

In cells: weighted mean HAZ (weighted n/ un-weighted n)

	2000	2005	2011
6 to 8 months			
Good: Does meet min meal freq.	-0.9693 (104/ 104)	-0.5398 (100/ 78)	-0.0867*** (202/ 181)
Bad: Does not meet min meal freq.	-1.1616 (416/ 374)	-0.5248 (20/ 13)	-0.5806 (339/ 345)
n: weighted/ un-weighted	520/ 478	120/ 91	541/ 526
9 to 11 months			
Good: Does meet min meal freq.	-1.5825 (127/ 106)	-1.2624 (74/ 61)	-1.0813** (190/ 147)
Bad: Does not meet min meal freq.	-1.7387 (370/ 288)	-1.2603 (79/ 61)	-1.4827 (261/ 242)
n: weighted/ un-weighted	497/ 394	153/ 122	451/ 389
12 to 14 months			
Good: Does meet min meal freq.	-1.6849 (224/ 224)	-1.3165 (111/ 99)	-1.3137 (220/ 201)
Bad: Does not meet min meal freq.	-1.9475 (269/ 199)	-1.7156 (73/ 55)	-1.3562 (259/ 250)
n: weighted/ un-weighted	493/ 423	185/ 154	479/ 451
15 to 17 months			
Good: Does meet min meal freq.	-2.1793** (215/ 199)	-1.8801 (82/ 69)	-1.5408 (199/ 198)
Bad: Does not meet min meal freq.	-2.5569 (210/ 191)	-2.0813 (63/ 48)	-1.7696 (185/ 227)
n: weighted/ un-weighted	425/ 390	146/ 117	383/ 425
18 to 20 months			
Good: Does meet min meal freq.	-2.3184* (251/ 212)	-1.8073*** (63/ 59)	-2.0767 (250/ 212)
Bad: Does not meet min meal freq.	-2.6174 (142/ 125)	-2.7798 (47/ 37)	-2.1618 (124/ 130)
n: weighted/ un-weighted	393/ 337	110/ 96	374/ 342
21 to 23 months			
Good: Does meet min meal freq.	-2.5746 (252/ 213)	-2.1313 (50/ 40)	-2.1843 (239/ 188)
Bad: Does not meet min meal freq.	-2.4218 (130/ 102)	-2.3478 (23/ 20)	-1.9682 (83/ 86)
n: weighted/ un-weighted	382/ 315	73/ 60	322/ 274
6 to 23 months			
Good: Does meet min meal freq.	-2.0276** (1172/1033)	-1.3921*** (480/406)	-1.4305 (1300/1127)
Bad: Does not meet min meal freq.	-1.8703 (1538/1304)	-1.8084 (306/234)	-1.3536 (1250/1280)
n: weighted/ un-weighted	2710/ 2337	785/ 640	2549/ 2407

Mgood=1, weighted.

* Indicate p-value significance compared with cell below; levels of significance: * p<=0.05, ** p<=0.01,

*** p<=0.001

Note: Minimum meal frequency is defined as three meals for non-breastfed children, 2 meals for breastfed children ages 6 to 8 months, and 3 meals for breastfed children ages 9 to 23 months (see methods for further explanation).

Table 2.67 A The association of meal frequency with height-for-age, ages 6 to 8 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age		-0.239 (-2.886, 0.004)	-0.157 (-1.574, 0.116)	-0.232 (-2.801, 0.005)	-0.239 (-2.902, 0.004)	-0.219 (-2.757, 0.006)	-0.209 (-2.619, 0.009)
Sex		0.005 (0.039, 0.969)	0.025 (0.182, 0.856)	-0.019 (-0.141, 0.888)	-0.007 (-0.053, 0.958)	0.068 (0.517, 0.605)	0.044 (0.334, 0.739)
Minimum meal frequency	0.323 (2.260, 0.024)	0.420 (2.873, 0.004)	2.294 (1.786, 0.075)	0.380 (2.578, 0.010)	-0.094 (-0.390, 0.697)	-0.138 (-0.590, 0.555)	0.353 (2.415, 0.016)
Interaction: MMF * Age			-0.264 (-1.469, 0.143)				
Poor Roofing				-0.354 (-2.602, 0.010)	-0.351 (-2.572, 0.010)	-0.318 (-2.421, 0.016)	-0.295 (-2.234, 0.026)
No Education					-0.500 (-2.545, 0.011)	-0.473 (-2.503, 0.013)	-0.149 (-1.018, 0.309)
Interaction: MMF * No Education					0.680 (2.231, 0.026)	0.793 (2.692, 0.007)	
Mother's height						0.066 (6.490, 0.000)	0.064 (6.284, 0.000)
Constant	-0.356	1.266	0.678	1.447	1.862	-8.856	-8.857
Adj. R Square	0.008	0.020	0.029	0.030	0.040	0.112	0.101
N	526	526	526	514	514	513	513

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, MMF, interaction of MMF and age, poor roofing, no education, interaction of MMF and no education, mother's height.

Table 2.67 B Interaction: Adjusted mean height-for-age by category of minimum meal frequency and education status in 6 to 8 month olds, 2011.

In cells: un-weighted adjusted mean HAZ (un-weighted n), difference in HAZ.

Education	Minimum meal frequency		Difference	p-value
	No	Yes		
No Education	-0.487 (261)	0.168 (90)	0.655	0.000***
Any Education	0.014 (79)	-0.152 (83)	-0.166	0.477
p-value	0.029*	0.161		

Mgood=1, un-weighted.

HAZ adjusted for covariates: age=6.96, gender=1.52, roofing=0.51, and mother's height=157.62.

(*) p<=0.1, * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.68 The association of meal frequency with height-for-age among 9 to 11 month olds, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age		-0.315 (-3.309, 0.001)	-0.229 (-1.894, 0.059)	-0.306 (-3.212, 0.001)	-0.290 (-3.051, 0.002)	-0.296 (-3.116, 0.002)	-0.269 (-2.862, 0.004)
Sex		0.020 (0.126, 0.900)	0.013 (0.085, 0.932)	0.052 (0.331, 0.741)	0.053 (0.337, 0.737)	0.066 (0.418, 0.676)	0.091 (0.587, 0.558)
Minimum meal frequency	0.337 (2.060, 0.040)	0.372 (2.298, 0.022)	2.614 (1.330, 0.184)	0.352 (2.169, 0.031)	0.011 (0.041, 0.968)	0.325 (2.002, 0.046)	0.328 (2.054, 0.041)
Interaction: MMF * Age			-0.224 (-1.144, 0.253)				
Poor Roofing				-0.233 (-1.459, 0.146)	-0.195 (-1.219, 0.224)	-0.196 (-1.223, 0.222)	-0.204 (-1.295, 0.196)
No Education					-0.520 (-2.438, 0.015)	-0.316 (-1.911, 0.057)	-0.251 (-1.536, 0.125)
Interaction: MMF * No Education					0.504 (1.511, 0.132)		
Mother's height							0.052 (3.928, 0.000)
Constant	-1.268	1.832	0.990	1.840	2.005	1.914	-6.603
Adj. R Square	0.008	0.031	0.031	0.033	0.043	0.039	0.075
N	389	389	389	382	382	382	381

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, MMF, interaction of MMF and age, poor roofing, no education, interaction of MMF and no education, mother's height.

Minimum dietary diversity

Table 2.69 Minimum dietary diversity: percent of children ages 6 to 23 months fed a minimum of 4 out of 6 possible food groups the 24 hours preceding the survey, by 6-month age group, breastfeeding status, and survey year.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
Breastfed only			
6 to 11 months	2.6% (1079/ 916)	2.0% (490/ 429)	1.4% (1084/ 1003)*
12 to 17 months	9.6% (1040/ 888)	8.5% (528/ 476)	5.6% (960/ 946)***
18 to 23 months	8.7% (877/ 695)	5.6% (319/ 288)	5.4% (746/ 657)**
6 to 23 months	6.8% (2996/ 2499)	5.5% (1338/ 1193)	3.9% (2792/ 2606)***
Non-breastfed only			
12 to 17 months	6.9% (58/ 78)	23.1% (26/ 33)	5.7% (53/ 118)
18 to 23 months	25.4% (142/ 148)	24.4% (45/ 65)	15.3% (131/ 154)*
6 to 23 months	18.9% (212/ 243)	20.7% (82/ 113)	10.8% (213/ 305)*

Mgood=0 or 1, weighted.

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: * p<=0.05,

** p<=0.01, *** p<=0.001

Table 2.70 Minimum dietary diversity: percent of children ages 6 to 23 months fed a minimum of 3 out of 6 possible food groups the 24 hours preceding the survey by 6-month age group, breastfeeding status, and survey year.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
Breastfed			
6 to 8 months	6.2% (566/ 505)	8.9% (270/ 233)	9.1% (604/ 580)*
9 to 11 months	14.8% (514/ 411)	14.0% (221/ 196)	11.4% (481/ 423)
12 to 14 months	28.2% (550/ 468)	24.2% (277/ 256)	16.4% (523/ 486)***
15 to 17 months	24.0% (491/ 420)	21.9% (251/ 220)	22.8% (438/ 460)
18 to 20 months	26.1% (456/ 376)	21.8% (188/ 167)	22.5% (400/ 368)
21 to 23 months	30.0% (420/ 319)	35.6% (132/ 121)	24.9% (346/ 289)
6 to 23 months	21.0% (2997/ 2499)	19.7% (1338/ 1193)	16.9% (2792/ 2606)***
Non-breastfed			
12 to 17 months	50.9% (57/ 78)	55.6% (27/ 33)	15.1% (53/ 118)***
18 to 23 months	47.6% (143/ 148)	47.7% (44/ 65)	41.2% (131/ 154)
6 to 23 months	49.8% (213/ 243)	54.3% (81/ 113)	30.0% (213/ 305)***
Region (breastfed only, 6 to 23 months)			
Tigray	8.4% (178/ 254)	9.0% (89/ 127)	17.2% (186/ 292)**
Affar	13.6% (22/ 115)	7.1% (14/ 84)	10.5% (19/ 187)
Amhara	13.8% (802/ 407)	7.4% (309/ 170)	12.1% (652/ 319)
Oromiya	26.3% (1215/ 542)	27.2% (497/ 220)	18.8% (1190/ 425)***
Somali	18.2% (22/ 122)	5.8% (52/ 67)	5.3% (57/ 168)
Benishangul-Gumuz	29.6% (27/ 174)	21.4% (14/ 94)	18.2% (33/ 240)
SNNP	22.2% (677/ 407)	24.7% (336/ 231)	19.2% (577/ 377)
Gambela	37.5% (8/ 156)	25.0% (4/ 63)	22.2% (9/ 194)
Harari	20.0% (5/ 119)	33.3% (3/ 58)	14.3% (7/ 163)
Addis Ababa	34.3% (35/ 96)	37.5% (16/ 36)	20.0% (55/ 95)
Dire Dawa	25.0% (8/ 107)	25.0% (4/ 43)	22.2% (9/ 146)

Mgood=0 or 1, weighted.

* Indicate p-values from Chi² test between 2000 and 2011; * p<=0.05, ** p<=0.01, *** p<=0.001

Table 2.71 Mean height-for-age by minimum dietary diversity status, 3-month age group (6 to 23 months), breastfeeding status, and survey year.

In cells: weighted mean HAZ (weighted n/ un-weighted n).

Breastfed only	2000	2005	2011
6 to 8 months			
Good: ≥ 3 foods	-0.8400 (32/ 32)	-0.9285 (19/ 17)	-0.1150 (51/ 39)
Bad: < 3 foods	-1.1444 (483/ 434)	-1.1443 (214/ 177)	-0.4117 (489/ 487)
N weighted/ un-weighted	515/ 466	232/ 194	540/ 526
9 to 11 months			
Good: ≥ 3 foods	-1.0289*** (72/ 68)	-0.4540** (26/ 18)	-0.9937* (55/ 50)
Bad: < 3 foods	-1.7582 (410/ 316)	-1.4186 (168/ 155)	-1.4136 (398/ 339)
N weighted/ un-weighted	482/ 384	195/ 173	453/ 389
12 to 14 months			
Good: ≥ 3 foods	-1.5515*** (137/ 101)	-0.9113*** (53/ 42)	-1.2147 (77/ 68)
Bad: < 3 foods	-2.0406 (336/ 300)	-1.8834 (164/ 144)	-1.3710 (397/ 362)
N weighted/ un-weighted	473/ 401	217/ 186	474/ 430
15 to 17 months			
Good: ≥ 3 foods	-2.0374*** (98/ 90)	-1.4580*** (42/ 32)	-1.4167* (92/ 89)
Bad: < 3 foods	-2.6121 (291/ 250)	-2.1548 (125/ 111)	-1.7506 (273/ 297)
N weighted/ un-weighted	389/ 340	167/ 143	365/ 386
18 to 20 months			
Good: ≥ 3 foods	-2.1497** (99/ 78)	-2.2168 (27/ 27)	-2.1782 (73/ 67)
Bad: < 3 foods	-2.6059 (295/ 213)	-2.3620 (94/ 76)	-2.1914 (268/ 242)
N weighted/ un-weighted	364/ 291	121/ 103	341/ 309
21 to 23 months			
Good: ≥ 3 foods	-2.3676 (96/ 70)	-3.0915 (29/ 17)	-1.8315* (72/ 59)
Bad: < 3 foods	-2.6614 (218/ 177)	-2.4518 (44/ 43)	-2.1986 (214/ 173)
N weighted/ un-weighted	314/ 247	73/ 60	286/ 232
6 to 23 months			
Good: ≥ 3 foods	-1.7849** (534/ 439)	-1.4711 (195/ 153)	-1.3713 (420/ 372)
Bad: < 3 foods	-1.9922 (2003/ 1690)	-1.7199 (810/ 706)	-1.3944 (2039/ 1900)
N weighted/ un-weighted	2537/ 2129	1005/ 859	2458/ 2272
Non-Breastfed only	2000	2005	2011
18 to 23 months			
Good: ≥ 3 foods	-2.2195 (48/ 53)	-1.2934 (10/ 12)	-1.2058* (51/ 50)
Bad: < 3 foods	-1.9683 (46/ 60)	0.5272 (10/ 14)	-1.7682 (64/ 65)
N weighted/ un-weighted	95/ 113	20/ 26	115/ 115
6 to 23 months			
Good: ≥ 3 foods	-1.6438 (82/ 84)	0.1009 (25/ 28)	-1.2018 (60/ 75)
Bad: < 3 foods	-1.8259 (76/ 111)	0.3427 (17/ 27)	-1.2376 (126/ 159)
N weighted/ un-weighted	157/ 195	42/ 55	186/ 234

Mgood=1, weighted.

* Indicate p-value significance compared with cell below; levels of significance: * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Table 2.72 The association of dietary diversity with height-for-age among 15 to 17 month olds, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age		-0.022 (-0.242, 0.809)	0.009 (0.094, 0.926)	-0.030 (-0.337, 0.736)	-0.043 (-0.476, 0.634)	-0.045 (-0.499, 0.618)	-0.049 (-0.559, 0.576)
Sex		0.472 (3.259, 0.001)	0.474 (3.272, 0.001)	0.399 (2.710, 0.007)	0.410 (2.794, 0.005)	0.412 (2.818, 0.005)	0.402 (2.826, 0.005)
Minimum dietary diversity	0.293 (1.693, 0.091)	0.305 (1.781, 0.076)	2.633 (0.755, 0.451)	0.287 (1.682, 0.093)	0.357 (1.236, 0.217)	0.255 (1.501, 0.134)	0.303 (1.814, 0.070)
Interaction: MDD * Age			-0.146 (-0.668, 0.505)				
Poor Roofing				-0.438 (-2.983, 0.003)	-0.399 (-2.714, 0.007)	-0.404 (-2.759, 0.006)	-0.404 (-2.838, 0.005)
No Education					-0.362 (-1.991, 0.047)	-0.402 (-2.568, 0.011)	-0.303 (-1.973, 0.049)
Interaction: MDD * No Education					-0.156 (-0.436, 0.663)		
Mother's height							0.058 (5.144, 0.000)
Constant	-1.787	-2.160	-2.662	-1.695	-1.275	-1.216	-10.276
Adj. R Square3	0.005	0.027	0.026	0.047	0.059	0.061	0.123
N	386	386	386	378	378	378	374

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, MDD, interaction of MDD and age, poor roofing, no education, interaction of MDD and no education, mother's height.

Table 2.73 The association of dietary diversity with height-for-age among 18 to 20 month olds, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age		-0.114 (-1.187, 0.236)	-0.121 (-1.119, 0.264)	-0.113 (-1.174, 0.241)	-0.111 (-1.167, 0.244)	-0.108 (-1.137, 0.256)	-0.114 (-1.294, 0.197)
Sex		-0.032 (-0.211, 0.833)	-0.033 (-0.216, 0.829)	-0.081 (-0.534, 0.594)	-0.083 (-0.554, 0.580)	-0.088 (-0.583, 0.560)	-0.014 (-0.104, 0.917)
Minimum dietary diversity	0.491 (2.703, 0.007)	0.508 (2.787, 0.006)	-0.074 (-0.016, 0.987)	0.511 (2.784, 0.006)	0.608 (2.271, 0.024)	0.447 (2.435, 0.015)	0.324 (1.895, 0.059)
Interaction: MDD * Age			0.031 (0.129, 0.898)				
Poor Roofing				-0.614 (-4.084, 0.000)	-0.567 (-3.779, 0.000)	-0.566 (-3.776, 0.000)	-0.572 (-4.134, 0.000)
No Education					-0.335 (-1.898, 0.059)	-0.405 (-2.614, 0.009)	-0.339 (-2.361, 0.019)
Interaction: MDD * No Education					-0.303 (-0.828, 0.408)		
Mother's height							0.078 (7.362, 0.000)
Constant	-2.161	0.039	0.156	0.430	0.599	0.595	-11.673
Adj. R Square	0.020	0.018	0.015	0.073	0.090	0.091	0.232
N	309	309	309	299	299	299	297

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, MDD, interaction of MDD and age, poor roofing, no education, interaction of MDD and no education, mother's height.

Table 2.74 The association of dietary diversity with height-for-age, ages 21 to 23 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t, p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Age		-0.150 (-1.344, 0.180)	-0.043 (-0.334, 0.739)	-0.026 (-0.198, 0.843)	-0.012 (-0.092, 0.927)	-0.013 (-0.102, 0.918)	-0.006 (-0.046, 0.963)	-0.085 (-0.765, 0.445)
Sex		0.187 (1.039, 0.300)	0.181 (1.011, 0.313)	0.198 (1.101, 0.272)	0.190 (1.056, 0.292)	0.190 (1.057, 0.292)	0.134 (0.757, 0.450)	0.134 (0.756, 0.450)
Minimum dietary diversity	0.300 (1.455, 0.147)	0.269 (1.300, 0.195)	9.165 (1.664, 0.097)	9.967 (1.811, 0.071)	10.044 (1.822, 0.070)	10.035 (1.824, 0.069)	6.813 (1.245, 0.215)	0.122 (0.582, 0.561)
Interaction: MDD * Age			-0.408 (-1.616, 0.107)	-0.446 (-1.768, 0.078)	-0.455 (-1.796, 0.074)	-0.452 (-1.793, 0.074)	-0.307 (-1.223, 0.222)	
Poor Roofing				-0.340 (-1.889, 0.060)	-0.315 (-1.733, 0.084)	-0.317 (-1.752, 0.081)	-0.358 (-2.016, 0.045)	-0.361 (-2.029, 0.044)
No Education					-0.250 (-1.034, 0.302)	-0.225 (-1.126, 0.261)	-0.207 (-1.057, 0.292)	-0.201 (-1.025, 0.307)
Interaction: MDD * No Education					0.080 (0.187, 0.852)			
Mother's height							0.048 (3.269, 0.001)	0.051 (3.538, 0.000)
Constant	-2.278	0.727	-1.602	-1.803	-1.921	-1.909	-9.405	-8.165
Adj. R Square	0.005	0.008	0.015	0.026	0.023	0.027	0.068	0.066
N	232	232	232	228	228	228	228	228

Mgood=1, un-weighted.

Dependent variable: HAZ

Independent variables: age, sex, MDD, interaction of MDD and age, poor roofing, no education, interaction of MDD and no education, mother's height.

Minimum acceptable diet

Table 2.75 Minimum acceptable diet: percent of children ages 6 to 23 months achieving the minimum dietary diversity (3 of 6 food groups) and the minimum meal frequency recommended for their age and breastfeeding status, by 6-month age group, region, and survey-year.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
6 to 11 months	6.4% (1088/ 932)	16.9% (320/ 261)	8.4% (1086/ 1010)*
12 to 17 months	19.7% (1094/ 965)	22.5% (458/ 395)	14.2% (977/ 1021)***
18 to 23 months	23.6% (1019/ 843)	25.2% (310/ 285)	23.9% (816/ 749)
6 to 23 months	16.4% (3202/ 2740)	21.6% (1087/ 941)	14.8% (2879/ 2780)*
Region (6 to 23 months)			
Tigray	8.6% (187/ 267)	6.3% (63/ 90)	17.3% (197/ 310)**
Affar	11.1% (27/ 133)	11.1% (9/ 49)	4.3% (23/ 221)
Amhara	10.0% (813/ 412)	10.0% (219/ 119)	8.4% (622/ 304)
Oromiya	21.8% (1333/ 590)	27.9% (438/ 193)	16.7% (1224/ 438)**
Somali	17.6% (34/ 157)	9.8% (41/ 51)	5.4% (74/ 212)*
Benishangul-Gumuz	26.7% (30/ 186)	20.0% (10/ 70)	15.2% (33/ 240)
SNNP	14.8% (708/ 427)	25.3% (281/ 194)	17.1% (613/ 398)
Gambela	28.6% (7/ 158)	33.3% (3/ 44)	20.0% (10/ 196)
Harari	16.7% (6/ 138)	33.3% (3/ 61)	14.3% (7/ 174)
Addis Ababa	25.5% (47/ 131)	42.1% (19/ 46)	19.4% (67/ 118)
Dire Dawa	20.0% (10/ 141)	0.0% (2/ 24)	20.0% (10/ 169)

Mgood=0 or 1, weighted.

Note: see methods for further definitions of variables used.

* Indicate p-values from Chi² test between 2000 and 2011; levels of significance: * p<=0.05,

** p<=0.01, *** p<=0.001

Table 2.76 Mean height-for-age by minimum acceptable diet status, 6-month age group (6 to 23 months), and survey year.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
6 to 11 months			
Good: Does meet min diet	-1.1663 (66/ 68)	-0.3225** (45/ 34)	-0.4528* (87/ 72)
Bad: Does not meet min diet	-1.4113 (941/ 798)	-1.0712 (229/ 181)	-0.8457 (908/ 846)
n: weighted/ un-weighted	1007/ 866	274/ 215	995/ 918
12 to 17 months			
Good: Does meet min diet	-1.5504*** (184/ 157)	-0.9268*** (74/ 60)	-1.2400 (125/ 124)
Bad: Does not meet min diet	-2.2159 (728/ 651)	-1.8988 (260/ 218)	-1.5055 (743/ 761)
n: weighted/ un-weighted	912/ 808	334/ 278	868/ 885
18 to 23 months			
Good: Does meet min diet	-2.2852* (189/ 155)	-2.0369 (43/ 37)	-1.9663 (168/ 147)
Bad: Does not meet min diet	-2.5309 (584/ 496)	-2.3076 (144/ 122)	-2.1358 (531/ 471)
n: weighted/ un-weighted	773/ 651	187/ 159	699/ 618
6 to 23 months			
Good: Does meet min diet	-1.8090 (438/ 380)	-1.0560*** (161/ 131)	-1.3823 (380/ 343)
Bad: Does not meet min diet	-1.9614 (2253/ 1945)	-1.6921 (634/ 521)	-1.3841 (2182/ 2078)
n: weighted/ un-weighted	2692/ 2325	795/ 652	2562/ 2421

Mgood=1, weighted.

* Indicate p-value compared with cell below; levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001

Consumption of iron-rich or iron-fortified foods

Table 2.77 Consumption of iron rich foods: percent of children 6 to 23 months that received an iron-rich food yesterday, by 6-month age group, region, and survey year.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
6 to 11 months	7.0% (1101/ 939)	5.4% (501/ 445)	10.7% (1117/ 1037)***
12 to 17 months	12.2% (1104/ 972)	13.4% (554/ 510)	14.0% (1016/ 1065)
18 to 23 months	15.5% (1027/ 848)	15.3% (366/ 354)	15.1% (881/ 815)
6 to 23 months	11.5% (3232/ 2759)	11.1% (1422/ 1309)	13.1% (3014/ 2917)*
Region (6 to 23 months)			
Tigray	10.8% (186/ 267)	20.7% (92/ 131)	20.3% (202/ 317)**
Affar	11.5% (26/ 133)	6.3% (16/ 95)	4.3% (23/ 232)
Amhara	9.9% (820/ 426)	7.0% (315/ 173)	10.2% (675/ 331)
Oromiya	11.2% (1351/ 598)	13.6% (537/ 240)	17.2% (1273/ 454)***
Somali	14.3% (35/ 157)	4.8% (62/ 82)	6.3% (80/ 234)
Benishangul-Gumuz	16.7% (30/ 187)	13.3% (15/ 101)	17.1% (35/ 255)
SNNP	12.9% (713/ 430)	8.5% (352/ 241)	5.9% (629/ 409)***
Gambela	37.5% (8/ 157)	25.0% (4/ 67)	33.3% (9/ 201)
Harari	14.3% (7/ 139)	25.0% (4/ 74)	12.5% (8/ 183)
Addis Ababa	19.1% (47/ 132)	27.3% (22/ 53)	16.2% (68/ 121)
Dire Dawa	20.0% (10/ 143)	20.0% (5/ 52)	20.0% (10/ 180)

Mgood=0 or 1, un-weighted.

* Indicate p-values from Chi² test between 2000 and 2011; * p<=0.05, ** p<=0.01, *** p<=0.001

2.C Risk factors: Access to health services – Tables

Access to Health Services around the time of birth: ages < 24 months

Place of delivery

Table 2.78 Place of delivery among children less than 24 months by survey year.

In cells: weighted %.

Place of delivery	2000	2005	2011
Home	94.9%	93.6%	88.2%
Public facility	4.7%	5.4%	10.0%
Private facility	0.3%	0.5%	1.4%
Other	0.1%	0.4%	0.5%
N (weighted/ un-weighted)	4328/ 3767	2006/ 1810	4283/ 4132

Mgood=0 or 1, weighted. (variable used=Del_place)

Table 2.79 Percent of children less than 24 months delivered at home by year and region. In cells: weighted % (weight n/ un-weighted n)

Regional home delivery	2000	2005	2011
Tigray	96.1% (255/ 366)	95.2% (125/ 173)	83.7% (263/ 419)***
Affar ^a	94.7% (38/ 185)	95.7% (23/ 128)	92.1% (38/ 358)
Amhara	97.2% (1101/ 552)	95.8% (456/ 252)	89.2% (933/ 451)***
Oromiya	96.2% (1781/ 783)	93.7% (763/ 336)	89.9% (1859/ 658)***
Somali ^a	91.7% (48/ 212)	96.4% (84/ 113)	92.9% (126/ 358)
Benishangul-Gumuz	93.0% (43/ 281)	80.0% (20/ 136)	81.6% (49/ 362)
SNNP	95.6% (959/ 582)	96.3% (490/ 337)	92.9% (886/ 576)*
Gambela ^a	72.7% (11/ 213)	80.0% (5/ 91)	71.4% (14/ 300)
Harari ^a	77.8% (9/ 196)	75.0% (4/ 106)	63.6% (11/ 237)
Addis Ababa	26.1% (69/ 194)	13.8% (29/ 68)	15.4% (91/ 161)
Dire Dawa	66.7% (15/ 203)	66.7% (6/ 70)	57.1% (14/ 252)
Total	94.9% (4329/ 3767)	93.6% (2005/ 1810)	88.2% (4284/ 4132)***

Mgood=0 or 1, weighted. (variable used= D_HomeDel2)

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

^a One or more cells have expected counts less than 5; Fisher's exact test (2-sided) used to determine significance (no stars indicates Fisher's exact test p>0.05).

Table 2.80 Percent of children less than 24 months delivered at home by year and livelihood or urban/rural locale.

In cells: weighted % (weighted n/ un-weighted n)

Livelihood & urban/rural home delivery	2000	2005	2011
Agricultural	96.0% (4112/ 3109)	94.9% (1801/ 1466)	89.7% (3326/ 2972)***
Agro-pastoral ^a	97.4% (78/ 199)	93.3% (104/ 100)	94.3% (406/ 405)
Pastoral ^a	97.2% (36/ 158)	97.3% (37/ 117)	92.5% (332/ 355)
Total livelihood	4226/ 3466	1942/ 1683	4064/ 3732
Urban	62.5% (421/ 604)	55.3% (150/ 248)	42.0% (564/ 707)***
Rural	98.4% (3907/ 3163)	96.7% (1856/ 1562)	95.2% (3719/ 3425)***
Total urban/ rural	4328/ 3767	2006/ 1810	4283/ 4132

Mgood=0 or 1, weighted (variable used=D_HomeDel2)

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided.

Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

^a One or more cells have expected counts less than 5; Fisher's exact test (2-sided) used to determine significance (no stars indicates Fisher's exact test p>0.05).

Table 2.81 The association of home delivery with height-for-age among children less than 24 months, 2011.

Dependent variables: HAZ; in cells: coefficient (t,p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Age		-0.122 (-30.295, 0.000)	-0.110 (-10.891, 0.000)	-0.110 (-10.974, 0.000)	-0.122 (-30.211, 0.000)	-0.123 (-30.237, 0.000)	-0.123 (-30.228, 0.000)	-0.121 (-30.686, 0.000)	-0.121 (-30.684, 0.000)
Sex		0.114 (2.161, 0.031)	0.111 (2.112, 0.035)	0.111 (2.118, 0.034)	0.112 (2.108, 0.035)	0.111 (2.096, 0.036)	0.111 (2.087, 0.037)	0.117 (2.266, 0.024)	0.117 (2.277, 0.023)
Home Delivery	-0.543 (-6.720, 0.000)	-0.561 (-7.796, 0.000)	-0.409 (-2.972, 0.003)	-0.425 (-2.805, 0.005)	-0.544 (-5.106, 0.000)	-0.515 (-4.695, 0.000)	-0.569 (-5.007, 0.000)	-0.523 (-5.405, 0.000)	-0.374 (-4.702, 0.000)
Interaction: Home Delivery * Age			-0.014 (-1.296, 0.195)	-0.014 (-1.277, 0.202)					
No Education				-0.619 (-4.323, 0.000)	-0.471 (-3.148, 0.002)	-0.491 (-3.190, 0.001)	-0.416 (-2.708, 0.007)	-0.180 (-3.047, 0.002)	-0.192 (-3.242, 0.001)
Interaction: Home delivery * No Education				0.381 (2.428, 0.015)	0.227 (1.389, 0.165)	0.254 (1.521, 0.128)	0.174 (1.043, 0.297)		
Poor Roofing					-0.528 (-3.168, 0.002)	-0.569 (-3.122, 0.002)	-0.393 (-2.085, 0.037)	-0.212 (-3.871, 0.000)	-0.235 (-4.346, 0.000)
Interaction: Home Delivery * Poor Roof					0.346 (1.958, 0.050)	0.393 (2.053, 0.040)	0.217 (1.100, 0.271)		
Poor Water Source						0.112 (0.550, 0.582)	-0.044 (-0.786, 0.432)	0.007 (0.121, 0.904)	-0.002 (-0.044, 0.965)
Interaction: Home delivery * Poor water source						0.171 (-0.805, 0.421)			
No Toilet							-0.243 (-1.369, 0.171)	-0.478 (-3.197, 0.001)	-0.101 (-1.888, 0.059)
Interaction: Home delivery* No toilet							0.277 (1.479, 0.139)	0.429 (2.699, 0.007)	
Mother's height								0.062 (15.075, 0.000)	0.062 (15.053, 0.000)
Constant	-0.464	0.666	0.542	0.732	0.952	0.951	0.983	-8.801	-8.889
Adj. R Square	0.012	0.218	0.218	0.224	0.227	0.227	0.227	0.277	0.275
N	3508	3508	3508	3508	3420	3419	3419	3398	3398

Mgood=1, un-weighted.

Dependent variables: HAZ

Independent variables: age, gender, home delivery, no education, poor roofing, poor water, no toilet, mother's height; including interactions.

Table 2.82 Interaction: Adjusted mean height-for-age by delivery place and toilet type, ages less than 24 months, 2011.

In cells: mean, standard error (90% CI); difference in HAZ, p-value for HAZ difference; difference in prevalence.

		Home Delivery	Facility or other delivery location	Difference, HAZ p-value
No toilet facility (bush/ field)	HAZ	-1.006, se=0.039 (-1.069, -0.942)	-0.912, se=0.124 (-1.116, -0.707)	0.094, p=0.471
	prev <-2 HAZ	0.304, se=0.010 (0.287, 0.321)	0.278, se=0.033 (0.223, 0.333)	-2.6 ppts
	N (un-weighted)	1592	146	
Any toilet facility	HAZ	-0.957, se=0.042 (-1.027, -0.887)	-0.434, se=0.086 (-0.575, -0.293)	0.523, p=0.000***
	prev <-2 HAZ	0.255, se=0.011 (0.236, 0.274)	0.206, se=0.023 (0.168, 0.244)	-4.9 ppts
	N (un-weighted)	1271	389	
Difference, HAZ p-value		0.049, p=0.393 -4.9 ppts	0.478, p=0.002** -7.2 ppts	

Mgood=1, un-weighted.

HAZ and prevalence adjusted for covariates at the following values (sample means): age=10.61, gender=1.50, no education=0.6648, poor roofing=0.53, poor water source=0.4956, and mother's height=157.1825.

(*) p<=0.1, * p<=0.05, ** p<=0.01, *** p<=0.001.

Antenatal care received

Table 2.83 Antenatal care personnel type among children less than 24 months by survey year.

In cells: weighted %; weighted n/ un-weighted n.

Antenatal care received from:	2000	2005	2011
Any Health Professional	25.7%	29.9%	43.3%***
No One (no ANC)	74.3%	70.1%	56.7%
N (weighted/ un-weighted)	4213/ 3675	1955/ 1764	4180/ 4016

Mgood=0 or 1, weighted.

Table 2.84 Antenatal care personnel type by age group in 2011.

In cells: weighted %; weighted n/ un-weighted n.

Antenatal care received from:	2011			
	<=23 months	24 to 35 months	36 to 47 months	48 to 59 months
Doctor	3.5%	2.5%	3.6%	4.1%
Nurse/ Midwife	29.1%	25.3%	30.8%	34.2%
Heath Extension Worker	10.7%	9.7%	10.0%	7.6%
No One (no ANC)	56.7%	62.5%	55.6%	54.1%
N (weighted/ un-weighted)	4180/ 4016	1446/ 1533	1076/ 1030	681/ 623

Mgood=0 or 1, weighted.

Table 2.85 Regional percent of children less than 24 months who received antenatal care form any health professional (i.e. any ANC) by survey year.

In cells: weighted % (weighted n/ un-weighted n).

Regional percent receiving any antenatal care (from any health professional)	2000	2005	2011
Tigray	35.1% (251/ 358)	32.8% (125/ 172)	64.6% (257/ 410)***
Affar	25.0% (36/ 179)	13.0% (23/ 123)	33.3% (36/ 346)
Amhara	16.8% (1092/ 548)	27.5% (447/ 247)	41.2% (920/ 444)**
Oromiya	25.7% (1715/ 755)	29.2% (734/ 324)	41.0% (1804/ 640)***
Somali	19.6% (46/ 205)	3.7% (82/ 110)	28.3% (120/ 337)
Benishangul-Gumuz	25.6% (43/ 276)	21.1% (19/ 134)	37.5% (48/ 349)
SNNP	28.6% (930/ 565)	33.8% (482/ 332)	40.9% (867/ 563)***
Gambela	45.5% (11/ 210)	40.0% (5/ 87)	53.8% (13/ 293)
Harari	44.4% (9/ 192)	40.0% (5/ 105)	60.0% (10/ 232)
Addis Ababa	85.3% (68/ 191)	89.3% (28/ 64)	96.7% (90/ 158)**
Dire Dawa	57.1% (14/ 196)	50.0% (6/ 66)	57.1% (14/ 244)
Total	25.7% (4215/ 3675)	29.8% (1956/ 1764)	43.4% (4179/ 4016)***

Mgood=0 or 1, weighted; (variable used=D_HomeDel2).

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) by year, within each row category. Both tests are 2-sided.

Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.86 Percent of children less than 24 months who received antenatal care from any health professional (i.e. any ANC) by year and livelihood or urban/rural location.

In cells: weighted % (weighted n/ un-weighted n).

	2000	2005	2011
Agricultural	24.4% (4000/ 3032)	29.4% (1762/ 1434)	42.8% (3240/ 2889)***
Agro-pastoral	26.0% (77/ 190)	26.5% (98/ 98)	39.0% (400/ 397)*
Pastoral	13.9% (36/ 156)	30.3% (33/ 111)	30.2% (324/ 341)*
Total	4113/ 3378	1893/ 1643	3694/ 3627
Urban	60.8% (403/ 584)	73.6% (148/ 240)	79.4% (557/ 692)***
Rural	22.0% (3811/ 3091)	26.3% (1808/ 1524)	37.8% (3623/ 3324)***
Total	4214/ 3675	1956/ 1764	4180/ 4016

Mgood=0 or 1, weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance:

* p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.87 The association of height-for-age with antenatal care among children less than 24 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t,p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Age		-0.131 (-23.447, 0.000)	-0.125 (-30.436, 0.000)	-0.125 (-30.567, 0.000)	-0.125 (-30.256, 0.000)	-0.125 (-30.361, 0.000)	-0.125 (-30.347, 0.000)	-0.124 (-30.898, 0.000)	-0.124 (-30.807, 0.000)
Sex		0.109 (2.040, 0.041)	0.110 (2.060, 0.039)	0.113 (2.137, 0.033)	0.106 (1.975, 0.048)	0.106 (1.972, 0.049)	0.106 (1.973, 0.049)	0.116 (2.223, 0.026)	0.117 (2.250, 0.025)
Antenatal care received	0.128 (2.109, 0.035)	0.094 (0.918, 0.359)	0.230 (4.276, 0.000)	0.372 (3.899, 0.000)	0.332 (2.973, 0.003)	0.318 (2.937, 0.003)	0.285 (2.594, 0.010)	0.262 (2.706, 0.007)	0.075 (1.334, 0.182)
Interaction: Antenatal care * Age		0.013 (1.564, 0.118)							
No Education				-0.169 (-1.951, 0.051)	-0.181 (-2.053, 0.040)	-0.176 (-2.002, 0.045)	-0.170 (-1.918, 0.055)	-0.097 (-1.127, 0.260)	-0.254 (-4.317, 0.000)
Interaction: Antenatal care * No Education				-0.370 (-3.151, 0.002)	-0.304 (-2.530, 0.011)	-0.285 (-2.346, 0.019)	-0.297 (-2.453, 0.014)	-0.285 (-2.445, 0.015)	
Poor Roofing					-0.232 (-3.135, 0.002)	-0.248 (-4.451, 0.000)	-0.248 (-4.443, 0.000)	-0.269 (-4.983, 0.000)	-0.287 (-5.380, 0.000)
Interaction: Antenatal care * Poor Roof					-0.070 (-0.629, 0.529)				
Poor Water Source						-0.035 (-0.481, 0.631)	-0.073 (-1.295, 0.195)	-0.021 (-0.375, 0.708)	
Interaction: Antenatal care * Poor water source						-0.099 (-0.874, 0.382)			
No Toilet							-0.026 (-0.350, 0.727)	-0.127 (-2.340, 0.019)	-0.132 (-2.433, 0.015)
Interaction: Antenatal care* No toilet							-0.025 (-0.221, 0.825)		
Mother's height								0.062 (14.892, 0.000)	0.062 (14.979, 0.000)
Constant	-0.970	0.192	0.130	0.254	0.423	0.458	0.491	-9.241	-9.168
Adj. R Square	0.001	0.214	0.214	0.225	0.228	0.229	0.229	0.278	0.277
N	3426	3426	3426	3426	3340	3339	3339	3318	3319

Mgood=1, un-weighted.

Dependent variable: HAZ.

Independent variables: age, gender, ANC received, no education, poor roofing, poor water source, no toilet, mother's height, as well as relevant interactions.

Table 2.89 The association of height-for-age with antenatal care among children less than 24 months, 2011, excluding Somalis and Gambela (which have taller than average mother's, see supplemental material).

Dependent variable: HAZ; in cells: coefficient (t,p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Age		-0.124 (-20.262, 0.000)	-0.120 (-27.181, 0.000)	-0.120 (-27.270, 0.000)	-0.120 (-27.093, 0.000)	-0.121 (-27.171, 0.000)	-0.121 (-27.180, 0.000)	-0.121 (-27.231, 0.000)	-0.121 (-27.677, 0.000)	-0.121 (-27.700, 0.000)
Sex		0.134 (2.331, 0.020)	0.134 (2.344, 0.019)	0.141 (2.471, 0.014)	0.133 (2.303, 0.021)	0.131 (2.284, 0.022)	0.130 (2.262, 0.024)	0.130 (2.259, 0.024)	0.128 (2.271, 0.023)	0.129 (2.278, 0.023)
Antenatal care received	0.207 (3.208, 0.001)	0.193 (1.750, 0.080)	0.281 (4.884, 0.000)	0.477 (4.519, 0.000)	0.395 (3.305, 0.001)	0.422 (3.503, 0.000)	0.325 (2.745, 0.006)	0.343 (3.099, 0.002)	0.308 (2.840, 0.005)	0.078 (1.267, 0.205)
Interaction: Antenatal care * Age		0.008 (0.932, 0.351)								
No Education				-0.113 (-1.172, 0.241)	-0.113 (-1.146, 0.252)	-0.112 (-1.141, 0.254)	-0.072 (-0.724, 0.469)	-0.076 (-0.770, 0.441)	-0.043 (-0.444, 0.657)	-0.227 (-3.473, 0.001)
Interaction: Antenatal care * No Education				-0.440 (-3.433, 0.001)	-0.350 (-2.652, 0.008)	-0.331 (-2.491, 0.013)	-0.359 (-2.694, 0.007)	-0.349 (-2.661, 0.008)	-0.331 (-2.573, 0.010)	
Poor Roofing					-0.340 (-4.288, 0.000)	-0.351 (-5.841, 0.000)	-0.360 (-5.996, 0.000)	-0.359 (-5.982, 0.000)	-0.318 (-5.393, 0.000)	-0.332 (-5.638, 0.000)
Interaction: Antenatal care * Poor Roof					-0.045 (-0.377, 0.706)					
Poor Water Source						0.033 (0.408, 0.683)	-0.006 (-0.092, 0.927)	-0.004 (-0.066, 0.948)	-0.006 (-0.093, 0.926)	-0.018 (-0.307, 0.759)
Interaction: Antenatal care * Poor water source						-0.131 (-1.076, 0.282)				
No Toilet							-0.210 (-2.627, 0.009)	-0.187 (-3.114, 0.002)	-0.193 (-3.271, 0.001)	-0.195 (-3.300, 0.001)
Interaction: Antenatal care* No toilet							0.052 (0.428, 0.668)			
Mother's height									0.053 (10.936, 0.000)	0.053 (10.994, 0.000)
Constant	-1.118	-0.036	-0.078	-0.002	0.218	0.212	0.331	0.320	-8.010	-7.893
Adj. R Square	0.003	0.205	0.206	0.217	0.224	0.225	0.227	0.227	0.260	0.258
N	2918	2918	2918	2918	2846	2845	2845	2845	2829	2829

Mgood=1, un-weighted.

Dependent variable: HAZ.

Independent variables: age, gender, ANC received, no education, poor roofing, poor water source, no toilet, mother's height, as well as relevant interactions.

Table 2.90 Interaction: Adjusted mean height-for-age and prevalence of stunting by education level and antenatal care received, ages less than 24 months, 2011.

In cells: adjusted mean HAZ or prevalence, standard error (90% CI); un-weighted n; difference in HAZ, HAZ difference p-value; difference in prevalence.

		No antenatal care	Anyone for antenatal care	Difference, HAZ p-value
No education	HAZ	-0.994, se=0.040 (-1.060, -0.927)	-1.016, se=0.055 (-1.106, -0.927)	-0.022, p=0.7469
	prev <-2 HAZ	0.286, se=0.011 (0.268, 0.304)	0.301, se=0.015 (0.277, 0.325)	+1.5 ppts
	N (un-weighted)	1451	756	
Any education	HAZ	-0.897, se=0.076 (-1.022, -0.772)	-0.635, se=0.059 (-0.732, -0.538)	0.262, p=0.0074**
	prev <-2 HAZ	0.272, se=0.020 (0.239, 0.306)	0.216, se=0.016 (0.190, 0.242)	-5.6 ppts
	N (un-weighted)	392	719	
Difference, HAZ p-value		0.097, -1.4 ppts p=0.2623	0.381, -8.5 ppts p=0.0000***	

Mgood=1, un-weighted.

Adjusted for covariates at the following values (sample means): age=10.53, gender=1.50, poor roofing=0.53, poor water source=0.4952, no toilet=0.51, and mother's height=157.1879.

Number of antenatal visits

Table 2.91 Mean number of antenatal visits and percent of children less than 24 months with any or no antenatal visits by survey year.

In cells: weighted mean number of visits (minimum number, maximum number); weighted %; weighted n/ un-weighted n.

Number of ante-natal visits	2000	2005	2011
Mean number of visits (min, max)	0.87 (0, 17)	1.07 (0, 20)	1.51 (0, 15)
0 antenatal visits	74.2%	70.1%	56.6%
1 or more antenatal visits	25.8%	29.9%	43.4%***
N (weighted/ un-weighted)	4221/ 3672	1957/ 1761	4192/ 4031

Mgood=0 or 1, weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided.

Levels of significance: *p<=0.05, **p<=0.01, ***p<=0.001.

Table 2.92 Regional percent of children less than 24 months whose mothers went to 1 or more antenatal care visits during pregnancy by survey year.

In cells: weighted % (weighted n/ un-weighted n).

Region	2000	2005	2011
Tigray	35.6% (253/ 361)	32.8% (125/ 172)	64.2% (260/ 414)***
Affar	25.0% (36/ 179)	9.1% (22/ 122)	33.3% (36/ 349)
Amhara	16.8% (1092/ 548)	27.7% (448/ 248)	40.8% (918/ 443)***
Oromiya	26.2% (1727/ 759)	29.3% (736/ 325)	41.3% (1814/ 644)***
Somali	21.3% (47/ 207)	3.7% (82/ 110)	28.3% (120/ 338)
Benishangul-Gumuz	25.6% (43/ 274)	21.1% (19/ 134)	37.5% (48/ 352)
SNNP	28.3% (926/ 564)	33.8% (482/ 332)	40.9% (867/ 563)***
Gambela	45.5% (11/ 212)	40.0% (5/ 87)	57.1% (14/ 295)
Harari	44.4% (9/ 189)	40.0% (5/ 103)	60.0% (10/ 232)
Addis Ababa	84.8% (66/ 183)	88.9% (27/ 62)	96.7% (90/ 158)**
Dire Dawa	57.1% (14/ 196)	50.0% (6/ 66)	53.8% (13/ 243)
Total	4224/ 3672	1957/ 1761	4190/ 4031

Mgood=0 or 1, weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.93 Percent of children less than 24 months whose mothers went to 1 or more antenatal care visits during pregnancy by year and livelihood or urban/rural location.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
Agricultural	24.6% (4011/ 3036)	29.5% (1765/ 2434)	42.9% (3249/ 2897)***
Agro-pastoral	26.0% (77/ 192)	25.8% (97/ 97)	39.5% (403/ 399)*
Pastoral	13.9% (36/ 156)	30.3% (33/ 111)	30.2% (324/ 344)*
Total	4124/ 3384	1895/ 1642	3976/ 3640
Urban	60.5% (400/ 573)	73.5% (147/ 236)	79.1% (556/ 691)***
Rural	22.2% (3821/ 3099)	26.4% (1811/ 1525)	38.0% (3636/ 3340)***
Total	4221/ 3672	1958/ 1761	4192/ 4031

Mgood=0 or 1, weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.94 The association of height-for-age with one or more antenatal visits during pregnancy among children less than 24 months, 2011.

Dependent variable: HAZ; in cells: coefficient (t,p).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Age		-0.130 (-23.412, 0.000)	-0.124 (-30.406, 0.000)	-0.124 (-30.545, 0.000)	-0.125 (-30.246, 0.000)	-0.125 (-30.357, 0.000)	-0.125 (-30.342, 0.000)	-0.124 (-30.922, 0.000)	-0.124 (-30.892, 0.000)
Sex		0.114 (2.146, 0.032)	0.115 (2.162, 0.031)	0.118 (2.233, 0.026)	0.110 (2.058, 0.040)	0.110 (2.057, 0.040)	0.110 (2.058, 0.040)	0.117 (2.262, 0.024)	0.117 (2.260, 0.024)
1 or more antenatal care (ANC) visits	0.144 (2.392, 0.017)	0.105 (1.033, 0.302)	0.242 (4.505, 0.000)	0.370 (3.889, 0.000)	0.336 (3.012, 0.003)	0.317 (2.932, 0.003)	0.281 (2.564, 0.010)	0.256 (2.648, 0.008)	0.081 (1.437, 0.151)
Interaction: ANC visits * Age		0.013 (1.576, 0.115)							
No Education				-0.173 (-2.004, 0.045)	-0.185 (-2.107, 0.035)	-0.181 (-2.056, 0.040)	-0.174 (-1.966, 0.049)	-0.099 (-1.159, 0.246)	-0.238 (-4.031, 0.000)
Interaction: ANC visits * No Education				-0.347 (-2.957, 0.003)	-0.280 (-2.333, 0.020)	-0.260 (-2.146, 0.032)	-0.274 (-2.263, 0.024)	-0.259 (-2.228, 0.026)	
Poor Roofing					-0.231 (-3.134, 0.002)	-0.252 (-4.538, 0.000)	-0.252 (-4.532, 0.000)	-0.276 (-5.127, 0.000)	-0.287 (-5.355, 0.000)
Interaction: ANC visits * Poor Roof					-0.080 (-0.724, 0.469)				
Poor Water Source						-0.037 (-0.504, 0.614)	-0.076 (-1.346, 0.178)	-0.022 (-0.410, 0.682)	-0.031 (-0.565, 0.572)
Interaction: ANC visits * Poor water source						-0.101 (-0.895, 0.371)			
No Toilet							-0.029 (-0.394, 0.694)	-0.130 (-2.397, 0.017)	-0.131 (-2.415, 0.016)
Interaction: ANC visits * No toilet							-0.021 (-0.184, 0.854)		
Mother's height								0.062 (15.037, 0.000)	0.062 (15.063, 0.000)
Constant	-0.973	0.177	0.115	0.244	0.414	0.452	0.487	-9.303	-9.204
Adj. R Square	0.001	0.214	0.213	.224	0.227	0.228	0.228	0.278	0.277
N	3440	3440	3440	3440	3355	3354	3354	3333	3333

Mgood=1, un-weighted.

Dependent variable: HAZ.

Independent variables: age, gender, 1 or more ANC visits, no education, poor roofing, poor water source, no toilet, mother's height, as well as all relevant interactions.

Table 2.95 Interaction: Adjusted mean height-for-age and prevalence of stunting by antenatal visits and education, ages less than 24 months, 2011.

In cells: mean HAZ or prevalence of stunting, standard error (90% CI); un-weighted n; difference in HAZ, p-values for difference in HAZ; difference in prevalence.

		No antenatal visits	1 or more antenatal visits	Difference, HAZ p-value
No education	HAZ	-0.993, se=0.040 (-1.059, -0.926)	-0.995, se=0.054 (-1.085, -0.906)	-0.002, p=0.976
	prev <-2 HAZ	0.285, se=0.011 (0.268, 0.303)	0.296, se=0.014 (0.272, 0.320)	1.1 ppts
	N (un-weighted)	1456	761	
Any education	HAZ	-0.893, se=0.076 (-1.018, -0.768)	-0.637, se=0.059 (-0.734, -0.540)	0.256, p=0.008**
	prev <-2 HAZ	0.272, se=0.020 (0.239, 0.305)	0.214, se=0.016 (0.188, 0.240)	-5.8
	N (un-weighted)	392	724	
Difference, HAZ p-value		0.100, p=0.245 -1.3 ppts	0.358, p=0.000*** -8.2 ppts	

Mgood=1, un-weighted.

Adjusted for covariates at the following values (sample means): age in months=10.51, gender=1.50, poor roofing=0.53, poor water source=0.4950, no toilet=0.51, mother's height=157.1949.

Access to Health Services around the time of birth: ages 24 months and older

Health card

Table 2.96 Percent of children ages 24 months and older with health card by survey year.
In cells: weighted %; weighted/ un-weighted n.

	2000	2005	2011
Has Health Card	42.9%	47.1%	55.8%
Does not have health card	57.1%	52.9%	44.2%***
N (weighted/ un-weighted)	6412/ 5783	2898/ 2636	6437/ 6312

Mgood=0 or 1; un-weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.97 Percent of children age 24 months and older with health card by region and survey year.

In cells: weighted % in region (weighted n/ un-weighted n).

Region	2000	2005	2011
Tigray	74.2% (453/ 638)	85.3% (204/ 288)	90.9% (430/ 691)***
Affar	14.3% (70/ 355)	9.4% (32/ 164)	26.5% (68/ 630)
Amhara	46.2% (1696/ 857)	51.3% (599/ 334)	58.4% (1506/ 733)***
Oromiya	41.3% (2566/ 1118)	43.0% (1193/ 528)	52.4% (2631/ 921)***
Somali	34.6% (78/ 385)	26.4% (140/ 196)	29.3% (191/ 534)
Benishangul-Gumuz	46.2% (65/ 432)	40.0% (30/ 195)	62.2% (74/ 536)
SNNP	28.3% (1337/ 821)	42.4% (637/ 443)	49.4% (1367/ 885)***
Gambela	40.0% (15/ 310)	50.0% (8/ 141)	55.0% (20/ 433)
Harari	78.6% (14/ 308)	66.7% (6/ 139)	80.0% (15/ 361)
Addis Ababa	90.9% (99/ 274)	86.8% (38/ 98)	97.3% (113/ 205)*
Dire Dawa	85.0% (20/ 285)	70.0% (10/ 110)	66.7% (21/ 383)
Total	42.9% (6413/ 5783)	47.1% (2897/ 2636)	55.8% (6436/ 6312)

Mgood=0 or 1, weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.98 Percent of children ages 24 months and older with health card by year and livelihood or urban/rural location.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
Agricultural	43.2% (6071/ 4699)	47.4% (2627/ 2135)	56.6% (5039/ 4547)***
Agro-pastoral	19.1% (131/ 372)	33.8% (130/ 149)	53.4% (624/ 626)***
Pastoral	7.7% (65/ 304)	40.0% (50/ 153)	40.9% (487/ 568)***
Total	6267/ 5375	2807/ 2437	6150/ 5741
Urban	76.4% (717/ 936)	78.3% (207/ 349)	70.3% (812/ 1049)**
Rural	38.6% (5695/ 4847)	44.7% (2690/ 2287)	53.7% (5626/ 5263)***
Total	6412/ 5783	2897/ 2636	55.8% (6438/ 6312)

Mgood=0 or 1, weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Measles vaccination

Table 2.99 Percent of children ages 24 months and older who have received measles vaccination by survey year.

In cells: weighted %; weighted n/ un-weighted n.

	2000	2005	2011
Received measles vaccination	33.0%	30.3%	58.3%
No vaccination	67.0%	69.7%	41.7%***
N (weighted/ un-weighted)	6230/ 5627	2692/ 2467	6303/ 6243

Mgood=0 or 1; weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.100 Regional percent of children ages 24 months and older who have received measles vaccination by survey year.

In cells: weighted % (weighted n/ un-weighted n).

Region	2000	2005	2011
Tigray	76.7% (442/ 621)	70.5% (183/ 258)	88.3% (426/ 685)***
Affar	7.1% (70/ 354)	10.7% (28/ 145)	27.5% (69/ 633)**
Amhara	37.2% (1620/ 822)	33.6% (557/ 310)	71.2% (1434/ 696)***
Oromiya	25.6% (2506/ 1093)	20.2% (1087/ 482)	46.8% (2580/ 901)***
Somali	28.8% (73/ 371)	2.1% (140/ 196)	27.1% (192/ 541)
Benishangul-Gumuz	24.6% (61/ 415)	21.4% (28/ 187)	64.4% (73/ 535)***
SNNP	24.7% (1315/ 807)	36.9% (607/ 423)	59.4% (1360/ 880)**
Gambela	28.6% (14/ 306)	37.5% (8/ 139)	50.0% (20/ 431)
Harari	61.5% (13/ 304)	33.3% (6/ 133)	68.8% (16/ 360)
Addis Ababa	88.5% (96/ 267)	86.8% (38/ 96)	96.5% (114/ 207)*
Dire Dawa	57.9% (19/ 267)	55.6% (9/ 98)	81.0% (21/ 374)
Total n	6229/ 5627	2691/ 2467	6305/ 6243

Mgood=0 or 1; weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.101 Percent of children ages 24 months and older who have received measles vaccination by year and livelihood or urban/rural location.

In cells: weighted % (weighted n/ un-weighted n).

	2000	2005	2011
Agricultural	32.7% (5892/ 4559)	30.3% (2437/ 1994)	59.9% (4915/ 4476)***
Agro-pastoral	16.9% (130/ 363)	11.5% (122/ 147)	51.0% (621/ 629)**
Pastoral	6.1% (66/ 305)	34.1% (44/ 132)	42.6% (488/ 567)**
Total n	6088/ 5227	2603/ 2273	6024/ 5672
Urban	69.5% (702/ 909)	63.4% (202/ 339)	75.3% (799/ 1044)*
Rural	28.4% (5528/ 4718)	27.6% (2491/ 2128)	55.9% (5508/ 5199)***
Total	6230/ 5627	2693/ 2467	6307/ 6243

Mgood=0 or 1; weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Treatment of diarrhea

Table 2.102 Percent of children ages 24 months and older who had diarrhea in the 2 weeks preceding the survey, by survey year.

In cells: weighted %; weighted n/ un-weighted n.

	2000	2005	2011
Had diarrhea in the past two weeks	18.6%	13.8%	9.7%
Have not had diarrhea	81.4%	86.2%	90.3%
N (weighted/ un-weighted)	6208/ 5599	2896/ 2636	6469/ 6332

Mgood=0 or 1; weighted.

Table 2.103 Type of treatment for diarrhea among children age 24 months and older who have had diarrhea in the 2 weeks preceding the survey, by survey year.

In cells: weighted % (weighted n/ un-weighted n).

Type of treatment for diarrhea	2000	2005	2011
No treatment	80.3% (926/ 762)	74.4% (297/ 253)	61.6% (385/ 429)
Shop, drug vendor, private pharmacy, traditional practitioner, or other treatment	8.1% (93/ 64)	4.0% (16/ 10)	3.5% (22/ 25)
Government facility or community based outlet	8.9% (103/ 143)	19.0% (76/ 68)	27.4% (350/ 190)
Private or NGO facility	2.7% (31/ 24)	2.5% (10/ 13)	7.5% (47/ 63)
N (weighted/ un-weighted)	1153/ 993	399/ 344	625/ 707

Mgood=0 or 1; weighted.

Table 2.104 Percent of children ages 24 months and older who have received medical, non-medical or no treatment for diarrhea, among those who have had diarrhea in the 2 weeks preceding the survey, by survey year.

In cells: weighted %; weighted n/ un-weighted n.

Treatment for diarrhea	2000	2005	2011
Received medical treatment	11.6%	21.6%	34.9%
Received non-medical treatment	8.1%	4.0%	3.5%
No treatment received	80.3%	74.4%	61.6%***
N (weighted/ un-weighted)	1153/ 993	399/ 344	625/ 707

Mgood=0 or 1; weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided.

Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.105 Regional percent receiving no treatment, among children ages 24 months and older who had diarrhea in the previous 2 weeks, by survey year.

In cells: weighted % (weighted n/ un-weighted n).

Region	2000	2005	2011
Tigray	78.9% (57/ 83)	75.0% (16/ 22)	68.6% (35/ 61)
Affar	80.0% (10/ 51)	100.0% (4/ 18)	55.6% (9/ 69)
Amhara	84.1% (239/ 116)	68.2% (66/ 38)	73.0% (126/ 62)*
Oromiya	81.8% (523/ 233)	70.7% (157/ 66)	52.3% (235/ 88)***
Somali	57.1% (14/ 62)	94.4% (18/ 22)	75.8% (33/ 87)
Benishangul-Gumuz	81.8% (11/ 87)	66.7% (3/ 24)	50.0% (12/ 87)
SNNP	76.2% (282/ 172)	79.4% (131/ 91)	63.7% (160/ 108)**
Gambela	66.7% (3/ 68)	50.0% (2/ 28)	50.0% (4/ 76)
Harari	66.7% (3/ 61)	100.0% (1/ 26)	50.0% (2/ 34)
Addis Ababa	87.5% (8/ 22)	100.0% (1/ 5)	55.6% (9/ 16)
Dire Dawa	66.7% (3/ 38)	NA (0/ 4)	50.0% (2/ 19)
Total n	1153/ 993	399/ 344	627/ 707

Mgood=0 or 1; weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * p<=0.05, ** p<=0.01, *** p<=0.001.

Table 2.106 Percent receiving no treatment for diarrhea, among children ages 24 months and older who had diarrhea in the previous 2 weeks by year and livelihood or urban/rural location.

In cells: weighted % (weighted n/ un-weighted n)

	2000	2005	2011
Agricultural	80.2% (1094/ 826)	74.7% (360/ 279)	61.7% (480/ 478)***
Agro-pastoral	78.1% (32/ 76)	61.1% (18/ 20)	59.2% (76/ 86)
Pastoral	90.1% (10/ 44)	100.0% (9/ 19)	75.0% (40/ 66)
Total n	1136/ 946	387/ 318)	596/ 630
Urban	48.8% (82/ 118)	83.3% (12/ 32)	51.2% (80/ 99)
Rural	82.7% (1071/ 875)	74.2% (387/ 312)	63.1% (545/ 608)***
Total	1153/ 993	399/ 344	625/ 707

Mgood=0 or 1; weighted.

* Indicates significance of Pearson Chi-Square test, or Fisher's exact test (where minimum expected cell count is less than 5) comparing by year, within each row category. Both tests are 2-sided. Levels of significance: * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

3. Needs relative to programmes

3.A Mapping of nutrition programme need at zone level.

Summary

To the DHS merged database geocodes were added, and this allowed both further merging with nutrition programme data, and with geographical definition at the level of administrative zone. There are 70+ zones compared to 12 regions, and the zone was considered a reasonable aggregation level, compromising between programme policy needs and stretching the data perhaps a bit further than it should (but we used categories of tertiles to mitigate this). Maps were developed combining three dimensions: child malnutrition prevalences (using underweight here to ensure that areas with high wasting were shown as high risk); extent of risk factor (e.g. of poor water supply); and programme presence, derived from the FMoH/REACH database, merged in. Maps get confusing with overlapping three dimensions, so the latter two were combined, as for example ‘high risk-low programme presence, medium risk-medium programme presence’ and so on.

We suggest that these maps are an important way in which the results of these analyses should be digested. They cover the four risk-programme areas, and suggest targeting priorities in geographical terms, as well indicating severity of risk and outcome (stunting).

Introduction

The mapping exercises are intended to provide a presentation of need (in terms of child malnutrition), with the extent of selected risk factors for malnutrition and estimates of access to relevant programs. The mapping process gets too complex if all three of these factors are overlaid, so the need (malnutrition prevalence) and risk factors are combined as a single dimension, with programme access as the second. The maps are at zone level. The four areas studied, and associated indicators were as follows (child stunting is common to each):

- Water, sanitation, and hygiene programmes; household water supply and toilet facilities;
- Infant and young child feeding practices; community-based nutrition (CBN) activities;
- Poverty; Production-based Safety Net Programme, PSNP
- Health service use indicators; access to health services (to come).

The maps then suggest targeting priorities geographically; other information in the database not shown in the maps, such as organizations working in the areas, can be used when developing interventions.

Results

Interpretation of maps: example of PSNP

For an example of how to interpret a group of maps, we will discuss the PSNP section here (beginning on page 18). First the anthropometry maps are presented, beginning with stunting. Here the worst off zones are illustrated in the darkest orange color, indicating that stunting prevalences are greater than 42%, and that they are in the highest tertile for stunting among all zones. The north-west part of the country appears to have the most zones in the highest tertile of stunting, with dark orange in the majority of Tigray, Amhara, and Benishangul-Gumuz. Note that the region names are displayed on this first map only for reference and reminder of where the regions are. A few zones in Afar, Oromia, and SNNP are also in this highest stunting tertile. The mid-orange color indicates zones in the middle tertile of stunting, with prevalence's between 34% and 42%. The pale yellow color depicts zones in the lowest tertile of stunting with less than 34% stunting prevalence. The next map illustrates the underweight prevalence by zone in tertiles, which can be interpreted in the same manner. Here however, different regions are highlighted with much of Somali and all of Afar in the dark-orange, highest tertile of underweight, with greater than 31% prevalence of underweight. The third map in the anthropometry section is of wasting prevalence. The wasting maps are not presented in tertiles, but rather in the pre-defined cutoffs of less than 10%, 10% to 20%, and greater than 20% prevalence of wasting. Afar and Somali again appear to be the worst off regions in terms of wasting.

The next page includes the two single variable maps of program presence and situation, which are also presented in tertiles. The program presence map illustrates where there is more PSNP presence; in this case, the darker green areas have the most programs, while the lighter green areas have the fewest programs. Given the way the data was merged together from REACH to DHS, the darker green zones, for example, can be interpreted as having more than 91% of their children living in a woreda with PSNP (or other program for other sections). The situation variable presented is extreme poverty, with the darker zones being those in the highest tertile of percentage of children living in extreme poverty households. Here, darker-blue is worse off.

The last two maps are the overlay maps. The first map presents only the highest need zones, those that fall into priority A or priority B (see methods section for full description of priority areas). Only one zone is in the priority A group, indicated by the darker purple colored zone in the middle. There are a few priority B zones in the west, including parts of SNNP, Oromia, Gambela, and Benishangul-Gumuz. The next map includes all of the categories. Here, the darkest green illustrates the best-targeted areas, or those with the most PSNP (program) presence and in highest need (tertile 3 of both underweight and extreme poverty). The mid-green color illustrates good targeting, or the medium need zones with the most PSNP presence. In addition to the darkest and mid-purples for priorities A and B which were represented in the previous map, the lighter purple color illustrates priority C, those medium to high need zones in the middle tertile of PSNP presence. Finally, the light blue zones are those in lower need of PSNP. It is

easy to see from this map, after digesting the prior maps that Somali and much of Affar are at least well targeted, in that they have a large presence of PSNP and are in the highest tertiles for both underweight and extreme poverty.

The two tables presented on the following page give further information on the groups presented in the maps, specifically, the number of zones per category. The first table shows need by program presence. This is consolidated using definitions of highest, medium, and low need that combines both the zones underweight and extreme poverty tertiles. These are defined in the methods and in the footnotes of the table. This condensed table illustrates how the groups are combined into priority A, B, C, good targeting, best targeting, and lower need. The footnote also lists which zones are in priority A and B groups. The single priority A zone which is seen as the darkest purple zone in the middle of the previous two overlay maps is North Shewa, in Oromia. The second table is the 27-cell full cross-tabulation table, combining three tertiles of PSNP presence, underweight prevalence, and extreme poverty. The colors in the cells match the groups depicted in the full overlay map. The 1 zone in the top-left cell is shaded dark purple to indicate it is the priority A zone of North Shewa, Oromia.

3. Needs relative to programmes

3.B Resources

Summary

Quantitative estimates were made with respect to donor resource disbursements for 2012 and 2013, from DAC data, by sector and sub-sector. A total of 3065 project in 2013 received donor funds, totaling \$3.67 billion. Health was the largest sector, with about \$650 million; within this nutrition was categorized as a sub-sector, with \$64 million. Projects in other sectors were examined for their relevance to nutrition; less than 10% of agricultural projects were specific to nutrition, and (by different estimates) 10-30% likely to have significant indirect nutrition benefit. WASH and health were similar. Population and reproductive health – mainly for HIV/AIDS – had \$300-400 million disbursed annually, arguably relevant to nutrition but not assessed as such.

The direct nutrition funding (\$64 million) while limited could be enough if focused through CBN to have a nutrition impact on a significant number of children judged by the usual norm of around \$10/household/year for impact – and indeed may already have done so. However, it is unclear how or whether other sectors are substantively orienting their resources towards nutrition impact (avoiding cosmetic addition of nutrition components). Mainstream development already appears to be driving much of nutrition improvement, and this could possibly be further enhanced by deliberately focusing non-nutrition (and non-health) resources on this objective.

Introduction

Donor resources used to support interventions relevant to nutrition are of interest with reference to:

- a. Their distribution between population groups: this can mainly be seen by administrative or geographic area (i.e. targeting), but also to some extent by project content (e.g. to pregnant women, infants and young children, farmers, refugees)
- b. The adequacy of the resources per capita; either as finance per head or household, but also as personnel
- c. Project content – relevance to nutrition or nutrition-sensitivity/specificity.

Project information is available from individual multilateral agencies, like World Bank, UN system agencies, although this is not always directly comparable. We decided to base most calculations reported here on the integrated reporting of all donor funds, available from the Development Assistance Committee (DAC) of OECD, henceforth know as DAC funds. This is based on the governmental origin of funds, and includes those that are channeled through multilateral routes (e.g. IDA of World Bank, UN agencies), and thus approximates to Official Development Assistance. The analysis we did in 2014 was

on 2012 DAC data; in early 2015 the 2013 data was posted on the web,¹ so additional calculations were done on these.

We did not have available any government financial data.

Data used from DAC. DAC data is available as a data matrix with project-year as the unit of analysis (or record), with 35 descriptive variables. This was downloaded into Excel, and thence to SPSS; both file types were used for analysis. The variables used for the results reported here were:

- Donor
- Short and long descriptions of project
- Project title
- Purpose code
- Purpose name
- Sector name
- Amount (US\$): gross disbursements (in 2012 or 2013).

We focused on these sectors: basic and general health; agriculture and forestry; water supply and sanitation; population policy and reproductive health (much of this AIDS funding); and basic nutrition, a sub-sector within health. To give context, the overall distribution of funding, by donor and sector, is first examined. Then resources relevant directly to nutrition, and for WASH, CBN, PSNP, and health services are analysed. Finally, we report attempts from these data to assess how far resources in one sector – agriculture – are likely to be of medium-term benefit to nutrition.

Distribution of aid resources by donor and sector.

A total of \$3.7 billion, or \$3,672 million, was reported as disbursed in 2013. The sources by donor are shown in table 3.15, and displayed in figure 3.38. As reported, these numbers are not all by national bilateral origin: both IDA (World Bank) and ‘Global Fund (to fight AIDS, TB, and malaria)’ for instance are ultimately funded by different national donors but reported under IDA and Global Fund headings; similar considerations apply to the UN agencies. Aside from these multilateral sources, US and UK provided the most funds – \$622m and \$516m respectively – with the US having over 500 projects to the UK’s 154; thus the average funds per project were over \$3m for UK and \$1m for US.

A total of 3065 projects were listed for 2013, with an average value of \$1.2m. The distribution is extremely skewed. The two largest sums, for \$143m and \$136m (UK) are for ‘sector budget support’ for basic services and basic health. The next three largest are for over \$100m. At the other end of the scale, the lowest 1960 projects (64%, two-thirds) are for less than \$200,000 each (roughly one thousandth of the largest sums). We need to keep this huge range in mind.

The allocation of the 2013 disbursement by sector is shown in figure 3.39. The health sector is the largest, totaling \$650m, and reproductive health (mostly AIDS) second with

\$450, altogether amounting to about \$1 billion in 2013, about 30% of the total, providing an average of \$10.5 per head. The emergency allocation was about \$400m, the third highest.

For directly relevant nutrition activities we are particularly concerned with the social sector, for which funding is shown in figure 3.40. The categories ‘general health’ (purpose code (PC) 12110-12191) and ‘basic health’ (PC 12220-12281) amount to the \$650m, and ‘basic nutrition’ is a sub-sector within basic health (PC 12240), with \$64m in 2013. WASH funds (PC 14010-14081) amounted to \$175m; interestingly, education/training for water supply and sanitation’ is a sub-sector (PC 14081), with 5 projects totaling \$759,000, see table 3.16. Education (PC 11110-11430) totaled \$315m, here broken down into four sub-sectors. The overall total was \$1,684m, or around \$18 per head.

Resources potentially directly relevant to nutrition.

We selected the sectors defined as health, reproductive health, WASH, and agriculture for a more detailed analysis. We analysed agricultural projects in part to understand how far it was feasible to categorize these as nutrition ‘-sensitive or –specific’, with the aim of possibly applying this to other sectors. This analysis also includes 2012 data.

The nutrition categories were defined as:

1. Clearly specifically nutrition, or direct nutrition interventions
2. ‘Nutrition-sensitive’ A, meaning assessed as likely to improve nutrition and have a significant impact; referred to as ‘dominant’ in EU terms
3. ‘Nutrition-sensitive’ B, meaning those assessed as possibly having an effect on nutrition but one considered indirect and hard to assess; referred to as ‘partial’ in EU terms.
4. An ‘other’ category was used for those with missing data, and those projects clearly irrelevant to nutrition.

Results from 2012 data. For 2012, a random sample was taken from all of each sector’s projects to give a rough estimate of the distribution of projects by nutrition category. The results are shown in table 3.17. Few of the health sector projects were specific to nutrition (estimated as 13% -- this rose to 19% when the nutrition sub-sector projects were included), but half (48% of the sample) were closely related and expected to have a significant impact. For water and sanitation (WASH) projects, only a total of 9 projects, 16% of the sample, were categorized as ‘nutrition-sensitive’ A. Reproductive health was similar – but this depends largely on how AIDS projects are regarded; clearly these have a significant impact in the sense of preventing or treating the symptoms of HIV/AIDS; we decided on this basis here to categorize most as nutrition-specific, recognizing that nutrition objectives are usually only implicit in such projects.

Turning to agriculture: this was given priority to see what emerged from trying to categorize projects that are likely to primarily affect nutrition indirectly, but nonetheless have much potential for doing so if designed for this. The categorization used the

criterion of whether the project, from the title, and the short and long descriptions provided in the DAC data, was likely to provide income, food, and thus improved food security for the poor and food insecure. The 243 agriculture projects apparently with sufficient data were all assessed thus. Of these, 19 projects were considered to be nutrition-specific – i.e. fairly direct – and 67 (28%) nutrition-sensitive A. The inferences are that (a) there is considerable potential for agricultural projects to impact nutrition, and (b) some assessment and identification of these is possible from the limited DAC data. Resources did not allow this assessment to be applied to further sectors; but it could be done.

Results from 2013 data. In 2013, 3065 projects were listed in all sectors, with gross disbursements of \$3,840 million. The allocation into the sectors of interest was as follows:

- Health, 302 projects, \$649 million
- Reproductive health, 319 projects, \$443 million
- WASH, 156 projects, \$175 million
- Agriculture, 366 projects, \$270 million.

Total, 1112 projects (34% of all projects), \$1,538 million (41% of all funds).

For nutrition itself (a subsector of health), there were 38 projects worth \$64 million.

These overall data are given in table 3.18, and here are compared with the 2012 data. Overall, the 1112 projects in 2013 within these sectors, worth \$1,538m, can be compared with the reported \$738 and 1210 projects in 2012. The differences in funds do not necessarily mean such large differences by year; these are annual disbursement figures and thus subject to variations from implementation rates. The numbers of projects are more stable, and here probably do reflect an increase in activity in health, and in nutrition.

To deal with the large number of projects, only those with disbursements above \$1 million were selected for further analysis. This was also applied to 2012 data for comparison. For 2013, this yielded the following numbers of projects *with total funds of \$1 million or more* for 2013 (see table 3.19):

- Health: 55 projects, \$608 million (this was 27% of the number of projects, and 94% of the funds)
 - Nutrition (as a sub-sector of health), 10 projects, \$57 million
- Reproductive health, 57 projects, \$397 million (18% and 90%, as above)
- WASH, 25 projects, \$153 million (16% and 87%, as above)
- Agriculture, 55 projects, \$223 (15% and 76%, as above).

The categorization of these large projects by nutrition relevance is shown in table 3.20. In health, again about 15% were assessed as nutrition-specific, i.e. direct nutrition projects; however few were considered nutrition-sensitive' A, and the majority only indirectly associated, 'nutrition-sensitive' B, at 69%. WASH and reproductive health projects were assessed similarly to health, mostly indirect.

The criterion for agricultural projects was again whether from their descriptions they seemed likely to alleviate poverty or food insecurity. A sample of typical descriptions is given in table 3.21. It should be clear that it is hard to conclude that most of these are likely to have a medium-term impact on the poor, sometimes due to the lack of detail.

Nutrition projects²⁸

Nutrition projects are defined as ‘basic nutrition’ within health, with a specific purpose code (12240), and the projects so classified are studied here. Nutrition projects were extracted from both the 2012 and 2013 DAC data. Those that appeared in both years – continuing projects – were identified by matching project title and donor. There were 25 nutrition projects in 2012, of which all but 8 continued into 2013. In 2013 there were 38 projects, thus 21 new ones. A listing of the projects is given in table 3.22.

The total funding for nutrition in 2012 was \$31.9 million, and in 2013 \$64.1m. The issues considered are:

- Distribution of funds, geographically and by population group
- Adequacy of the resources/head, or resource intensity
- How the resources are used, or project content, with reference to relevance to causes of malnutrition and hence likely impact on child malnutrition.

Resource distribution geographically. There is very little information from the DAC data concerning resource distribution, but we do have the project distributions and targeting from the mapping exercise in the previous section. This was obtained from a different source (REACH enquiries to donors and government), but was at the same time and should have referred to much the same projects. Roughly, the inferences from the mapping probably apply to the distribution of project resources. This is discussed in the next section, on gaps and opportunities. Nothing new is brought to this in terms of targeting from the DAC data.

Resource intensity. Adequacy of resource intensity can be approximated by comparing the actual intensity with norms derived from experience. We recently did a meta-analysis of project reports from many countries, using both \$/household and community health/nutrition workers/1000 children (hhds/CHNW), to assess levels of intensity associated with nutrition impact.² This, and previous work, suggested that around \$10/household/year (hhd/yr), and/or 1 CHNW/20 households (part-time) was associated with impact, approximated as increasing the rate of improvement by 1-2 ppts/year (in stunting or underweight). The association was stronger with the CHNW calculation. The relationship is considered likely to be non-linear, meaning that before a certain intensity level little improvement is seen; this level is somewhere below \$10/hhd/year, and probably above \$5/hhd/yr. The important implication of this is that using too few resources does not simply improve nutrition more slowly, but may not contribute at all, and thus is wasted.

²⁸ Purpose code 12240

Evaluation results are available specifically of the community-based program in Ethiopia, from the start (2008) to 2013. Based on the program data reported from the weighing component, it was estimated that the CBNW to household ratio averaged about 1:15 – well within the likely effective range – and that the reduction in underweight amounted to about 10 ppts in the first two years of programme implementation.³ Second, from baseline and midline surveys of tranches 2 and 3 of the CBN (i.e. launched in 2009 and 2010), we estimated that the CBN added 4-5 ppts/year to stunting reduction, and this was associated with measures of programme intensity.^{4,5} These results were compatible with each other, and provide some basis for assessing adequacy.

The overall donor funding level for nutrition of \$64m in 2013 amounts to approximately \$4/hhd/yr. In principle, this would provide nearly the \$10/hhd/yr estimated to be needed for impact, if all were used for community-based programmes, and the funds covered nearly half the country (as the CBN approximately does). Of course, not all the \$64m (in 2013 terms) is used for direct nutrition work at the community level, but this does indicate that the nutrition funds, although not generous, are not way off what would be needed; particularly as government resources would be included (if we knew them).

As one source of comparison, the World Bank project developed to support the National Nutrition Programme (2008-13) initially committed \$30m, in the expectation that around \$300m could be raised from donors for the 5 year period: again about \$60m/yr, to cover a major portion of the country.

A tentative conclusion would be that absolute availability of funds for nutrition is probably not the most important constraint in running effective programmes. The use of the funds – the programmes' content – must also be considered.

Programme content. Based on interpretation of the DAC descriptive data (title, short and long descriptions), a majority of the 2013 funding appears relevant to community nutrition programmes – roughly estimated at \$42m, which mainly excludes emergency funding.

The projects for which there is evidence of effectiveness (on stunting) are primarily community-based.² This needs to be compared with the efficacy evidence, as given for example in the Lancet series,⁶⁻⁹ where it is not translated into evidence for effects in large scale and national programs. Further, the issue is as much the route or platform by which interventions reach needy mothers and children. For example, as shown in section 3, changes in infant and young child feeding are likely to lead to improved child nutrition and reduced stunting; and the efficacy data (e.g. in the Lancet) supports this. The question is: how to best foster the behavioural changes in infant and child feeding practices on a national scale; many attempts (e.g. through traditional nutrition education) have failed; it now seems that supporting a network of community workers, and their supervision through the health system, is effective on a large scale. This impact may indeed not only be due to the child feeding behaviour change – the community worker

facilitates referral of sick children, maternal participation in ANC, and other activities with direct and indirect benefits to child nutrition.

Not all projects at present put the focus at the community level; but they could. Moreover, a number of well recognized projects, like ‘Alive and Thrive’ and ‘Engine’ as well as UNICEF’s support to CBN, do focus on the community and have established means of doing this.

A far-reaching policy decision would be to ensure that nutrition programmes aimed at improving general child nutrition (as biomarked by stunting) should use the resources primarily at community level.

A second area needing attention concerns micronutrient deficiencies. Salt iodization needs continuing support, as Ethiopia has one of the lowest levels anywhere, carrying a significant risk of permanent damage to unborn children. Pregnant women cannot wait. Anemia as shown earlier remains widespread, and focused in certain areas. A study completed recently by Emory-Tulane on women’s nutrition concluded that there was no alternative to making the distribution of iron supplements (or iron-folate, or possibly multiple micronutrient supplements containing iron) work, from central to peripheral levels, the latter through the health and ante-natal care systems.¹⁰ This deserves higher attention.

The question of vitamin A is controversial: the present authors have shown evidence that periodic distribution of massive doses of vitamin A are unlikely to have any benefit.¹¹ Others have suggested that some actual risks are involved in these blanket distributions.¹² One matter is clear and not controversial: periodic (6-monthly) vitamin A distribution has little or no effect on vitamin A deficiency. Therefore the continuation of high dose vitamin A distribution needs to be reconsidered.

3.B References

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3. Needs relative to programmes

3.C Results of qualitative components of situation analysis work

Summary

Field visits to selected woredas aimed to gain information on operational programmes and how these met needs. The programmes reviewed were along the same lines as other analyses – WASH, Alive and Thrive (A&T), CBN and GMP, the Agricultural Growth Programme, ‘ENGINE’ (Empowering New Generations in Improved Nutrition and Economic opportunities), and PSNP (Productive Safety Net Programme).

Those programmes aimed directly at children’s nutrition (A&T, CBN, ENGINE) had shown successful implementation although with resources seemingly only just in the range expected to bring significant impact, and increased capacity, resources, and extension to more of the population would be expected to enhance the impact. The programme content of these was perhaps more adequate than the resourcing and capacity. Nonetheless improved training materials (including e.g. more age-specific focus for IYCF) and supervision present opportunities that should be taken. Integration of frontline worker activities between sectors (e.g. health/nutrition with agriculture) was seen to be locally viable, and needs sectoral encouragement and resources. Observations have been integrated into interpretation of the quantitative findings.

Introduction

Qualitative field work was undertaken to better understand interventions in Ethiopia with the potential to address need (identified in the correlational analyses), and identify gaps and opportunities in current interventions. The results of:

- 1) selected project case studies and
- 2) selected woreda case studies

are described below. Note that the term ‘project’ is used for ease, as all identified support the overarching Government of Ethiopia’s National Nutrition Programme (NNP). Results from woreda field visits are used to further describe project implementation at local level. The field findings on woredas and project case studies are integrated below.

Six projects were identified as relevant to factors associated with undernutrition based in part on the correlational analysis results, and having sufficient scale to address factors either currently, or the potential to do so in the future. Each project is described below to the extent information could be obtained, highlighting important aspects of intervention area, coverage and implementation related to nutrition outcomes. Detailed descriptions of each project with references can be found in the Supplementary Material. Woreda case studies were undertaken via field assessment, to better understand implementation of projects at the local level. Summaries of observations relevant to each project are described. Woreda case studies are further described in

Supplementary Material. Findings from project investigation, including field assessment, are summarized in table 3.23.

One WASH National Program (OWNP), One WASH Plus (OWP) and Water, Sanitation and Hygiene, Multiple Use Services and Community Based Nutrition (WASH/MUS/CBN)^{cc}

The OWP is a collaboration between the GoE, UNICEF and other development partners to improve WASH access and quality. The goal is to achieve universal access to clean water and sanitation, and to encourage integrated health behaviours through integration of WASH activities. As of 2014, 52% of the population had access to an improved water source and 24% had access to improved sanitation.¹ OWP falls within the OWP, is supported by UNICEF and focuses on urban areas to accelerate WASH implementation and garner lessons learned to support the national programme.

OWP is a targeted project, covering eight towns with small populations to better understand cost-effective implementation strategies. This concept is important as urbanization has increased in Ethiopia recently, and is expected to further increase in coming years. Both OWP and OWP activities support water supply and sanitation access for households, communities (shared), schools and health facilities.

The WASH/MUS/CBN project is the most directly relevant to nutrition, integrating water supply, sanitation access and hygiene promotion with use of water for institutions (schools, health facilities) and community based nutrition activities (GMP). A total of 55 woredas are covered by the integrated programme, providing services at both household and facility levels. In addition to the usual route of HEW promotion, schools are utilized for promotion of sanitation and nutrition, involving creation of clubs and Behavioural Change Communication (BCC), activities that encourage adolescent nutrition interventions in direct support of the NNP. The project also links to the agriculture sector, encouraging schools to develop gardens for income generation, and strengthening food security at the community level. Nutrition outcomes associated with the WASH/MUS/CBN programme will be evaluated in surveys planned for 2015 and 2017, to follow a baseline conducted in 2013.

Observations from field study. WASH interventions at local level are not seen as specific to the OWP, as interventions are designed to be national, i.e. the program is supported by the Government. Coverage of water access interventions at household level within the OWP is variable, particularly when considering functioning water schemes. Field studies consistently demonstrated that access to improved water supplies for drinking and home use is a major difficulty, across regions and livelihood types. Even where water access was established, equipment was not functional and local technical capacity for repair did not exist. Where water access was limited (requiring travelling for several hours to obtain), women responsible for fetching water spent increasing amounts of time away from home, inhibiting mothers' capacity to provide adequate care of children, in turn likely to negatively affect nutritional status.^{dd}

^{cc} Intervention area: water, sanitation and hygiene

^{dd} No association was found from the DHS surveys between distance to water and child growth.

Coverage of water access at schools is high, as it is at health facilities, even in agro-pastoralist areas (access must be established for the facility to be built). In all woredas visited, the OOWNP provides for sanitation and hygiene promotion coupled with water access, though ability to implement the appropriate hygiene and sanitation practices is limited by lack of water. Resource intensity at local level is unknown. Targeting of water interventions is universal, not specific to nutrition status. However, targeting of interventions among geographic populations with a relatively accessible source does exist, therefore missing those most in need. More expensive, innovative schemes are needed to supply water to households with a less accessible source, and these require a primary mapping of water in the area in the process of planning. The content of the OOWNP is optimized to meet its objectives and in line with those needed to improve nutritional status. However, it is critical that education on appropriate use of water and sanitation and hygiene practices is coupled with establishment of water access to meet nutrition objectives to improve nutrition status of PLW and young children.

Alive and Thrive (A&T)^{ee}

A&T is specifically focused on improving IYCF practices, aiming to improve practices of breastfeeding and complementary feeding based on evidence of their importance in infant and child nutrition. In its first phase from 2009-2014, the project aimed to demonstrate effectiveness in improving IYCF and reducing child undernutrition through activities from federal to community levels. Activities included advocacy, mass media, capacity building of health and community workers, educational activities tailored to local kebele needs, distribution of educational materials and use of various community organizations (e.g. women's associations, schools, faith-based organizations) for practice-based implementation. The second phase of A&T (2015-2020) will shift from multi-level activities to federal and regional focus. Implementation will be limited to one region, Amhara, and evaluation will be based on global applicability.

In the second phase approach, A&T will work with UNICEF and implementing partners through the following strategies, to improve IYCF practices:

- 1) development of national SBCC framework to be used multisectorally, and NNP advocacy
- 2) capacity enhancement of HEWs and the WDA (indirectly, through HEWs) to provide IYCF services
- 3) increase demand for improved IYCF services and practices through mass media and
- 4) community mobilization using local groups (e.g. religious gatherings, women's groups) to support IYCF practices of mothers

The first phase was the focus of this review, as the implementation has ended and evaluations are available. Phase I of A&T was implemented in four regions (Tigray, Amhara, Oromia and SNNPR), targeting caretakers of under-2 children in 150-160 woredas. The project is estimated to have reached 2 million mothers of children under-2 via interpersonal communication and/or radio messages. In baseline and process evaluations in SNNPR and Tigray (2009, 2013), the rate

^{ee} Intervention area: infant and young child feeding (IYCF)

of exclusive breastfeeding increased from 72% to 80%, and dietary diversity and minimum meal frequency practices also improved.²

In three rounds of sentinel site surveys (SSS) conducted in eight woredas (two in each region) improvements in access to IYCF services and messaging, feeding practices during illness, breastfeeding (multiple indicators) and complementary feeding (multiple indicators) were found.³ Further, reduction in prevalence of undernutrition (stunting, underweight, wasting) was found in all woredas (using aggregated data). However, within the two surveillance woredas in Amhara region, there was no improvement in any of the measure of undernutrition. In SNNPR and Tigray, baseline and process evaluations (2009-2013) showed improvements in exclusive breastfeeding, dietary diversity and minimum meal frequency.

Observations from field study. The current coverage of and participation in A&T at local level was not observed, as interventions were not ongoing at time of field study, given the end of the first project phase. However, woredas visited in which the project was previously implemented suggested that coverage was high, with nearly all kebeles in implementing woredas having access to interventions. Participation was also high, with nearly all PLW and caretakers of children under two years of age accessing IYCF activities and/or being reached with mass media messages on appropriate practices.

Resource intensity estimated as \$2.2 per head (per year, latter two years of the programme) was apparently adequate, for a range of activities (e.g. media, capacity building, material development).

Targeting of A&T activities was for all PLW and under-2 children, not specific to those only designated with chronic or acute undernutrition. The content of A&T activities appeared appropriate to meet project objectives of improving IYCF, thus likely to improve nutritional status.

Importantly, capacity building of community workers was a major activity of the first phase of A&T, vital for implementation of IYCF activities. During field study, officials interviewed constantly cited support of the project in capacity building as important for implementation of IYCF activities at local level. It will be important to understand if the second phase of the project, in which local activities are removed, suffers from lack of enhanced capacity building from Government partners, or if sustained capacity can be demonstrated.

Community based Nutrition (CBN) / Growth monitoring and promotion (GMP)^{ff}

CBN/GMP is part of the Community Maternal, Neonatal and Child Health (CMNCH) package, one of the foremost components of the Government's NNP, and is the major platform for delivery of promotive and preventative nutrition services at the community level, aiming to improve the nutritional status of women, infants and young children. It is.

^{ff} Intervention area: IYCF, community based programme

Activities within the CBN/GMP programme include;

- monthly GMP for caregivers of children 0-23 months (including PLW), monthly community conversations;
- delivery of vitamin A, biannually for each child, but provided monthly within routine services;
- deworming, biannually for each child but provided monthly within routine services
- acute malnutrition screening (MUAC) through either routine (monthly) services or Community Health Days (CHDs) for children 6-59 months of age and PLW
- referral to the health facility (HF) as needed;
- and linkages with multi sectoral services (agriculture, WASH, social protection) as needed.

CHDs are in process of being transitioned to routine services per Government mandate. The programme also aims to stimulate demand for health services, importantly antenatal care (ANC), as well as provide linkages to multi sectoral services available at the community level, e.g. WASH, education, agriculture and social protection.

In the programme's initial phase (2008-2011), CBN/GMP was to be implemented at the community level by Volunteer Community Health Workers (VCHWs) at a planned ratio of 1VCHW/50 households, supported by Health Extension Workers (HEWs)^{gg}. Since 2012, the tasks of monthly growth monitoring and promotion (including IYCF counseling) have shifted to the HEWs, supported by the Health Development Army (HDA), volunteers whose main responsibilities are social mobilization and community outreach. The intended ratio of HDA member to household is 1:5. The CBN/GMP is implemented in the four regions of Amhara, Oromia, SNNP and Tigray, and by design targeted to rural woredas, and all kebeles within rural woredas. CBN/GMP implementation has expanded from the first tranche (phase) of 39 woredas in 2008, to the sixth tranche of a total 386 woredas in 2014, covering approximately half of all woredas in the country, an estimated 59 estimated million persons.

Evaluation of the CBN programme in 2012 found improvements in household contacts with VCHWs and HEWs, as well as maternal and child nutrition behaviours within sampled areas. In both tranches 2 and 3, significant improvements were found in the proportion of women taking iron folate during pregnancy; proportion of women reporting "eating down" during pregnancy; minimum dietary diversity among children 6-23 months; minimum acceptable diet among children 6-23 months. In Tranche 2 only, there was a significant increase in exclusive breastfeeding under 6 months of age. Crucially, sampled areas reporting high coverage of the programme reported large effects on stunting. In Tranche 2 coverage was defined as the amount of time spent by VCHWs on CBN activities and "high" VCHW activity areas had a stunting reduction of 6.8ppts/year while "low" VCHW activity areas had stunting reduction of 1.2ppts/yr. A similar trend was seen in Tranche 3, in which coverage was defined using woreda routine reports on child weighing: stunting was reduced by 5.3ppts/year in "high" activity areas while stunting increased by 2.9ppts/year in areas that did not report any CBN activity.⁴

^{gg} Note that a ratio of 1:15 approx was determined with about 30% participation

In addition to the CBN evaluation, trends in underweight prevalence among participating children using routinely collected GMP data were examined. The data were collected monthly from 172 woredas from June 2008 to the end of 2012, aggregated to regional level and analyzed separately for each region (SNNP, Amhara, Oromia and Tigray). The analysis found that the CBN program appears associated with about 10 percentage point decrease in undernutrition in the first year of the program.⁵ This was fairly consistent across each tranche and across the four regions, typically from about 25% to 15%. This finding was in line with the results from the CBN evaluation.

The most recent compilation of these data, shown earlier in figure 1.2, suggests that among participants (now reaching 50% in covered woredas) the underweight prevalence has fallen to less than 10%, though observations in the field could not confirm this.

Resource intensity estimates were around \$7 US per under-2 child per year for the monthly community-based CBN/GMP components focused on under-2 children (e.g. the initial training and integrated refresher training of HEWs, cascade training of HDA, GMP equipment and supplies, review meetings, and implementation support). These estimates did not include the costs of acute malnutrition screening; six-monthly vitamin A supplementation, or deworming, which are also delivered through the CBN platform)^{hh}.

Observations from field study. At local level, coverage of CBN/GMP was high in agrarian regions and low in pastoralist regions per programme design. One hundred percent of kebeles in targeted woredas had access to CBN/GMP, as it is a national programme. Participation was variable, ranging from less than 30% in some kebeles visited to nearly 100% (per last month's reports, among children less than two years of age). However, in some woredas visited participation did decrease in some months, especially if populations are affected by situations requiring migration, e.g. water shortages. Resource intensity for CBN/GMP at local level in financial terms is unknown, but has been assessed as CHNWs:household ratios (which are anyway more useful).^{4 5} With regards to HEW and HDA capacity for implementation of CBN activities, capacity is variable as some partners with presence in woredas support enhanced training of community workers while others do not (e.g. partner support for enhanced GMP training and supervision).

The growth monitoring component of CBN/GMP is targeted to all under-2 children, while counselling for growth faltering is targeted to those malnourished, i.e. moderately or severely underweight. This poses a problem, as those identified as underweight were reportedly low, therefore targeted counselling was provided to a small proportion of caretakers of under-2 children.

The content of CBN/GMP is somewhat optimized to meet its own objectives of providing targeted counselling to growth faltering children, and linking all PLW and young children to

^{hh} This is based upon an estimation of the number of under-2 children in rural households in the four large regions (Amhara, Oromia, SNNPR, Tigray) based upon UNICEF's Nutrition Woreda Mapping (using population projections from the CSA 2007 Census) and estimates on costs of CBN/GMP implementation equipment and supplies and IRT support from UNICEF.

needed services relevant for maintaining or improving nutritional status outside the health sector. However, CBN/GMP is not fully optimized for improving nutrition objectives if participation is low (shown to be 30% in evaluations) and targeted counselling is provided to approximately 10% of participations, i.e. those who are identified as having faltering growth.

The quality of IYCF promotion is variable, dependent on HEW time and skills and support of HDA. Targeted IYCF for growth faltering reaches only a small proportion of children under-2 by itself – therefore it should be coupled with sufficient ‘community conversations’ for IYCF message delivery to caretakers of children without faltering growth.

Agricultural Growth Programme (AGP)ⁱⁱ

The AGP is the Government’s national programme for increasing agricultural productivity and market access for crops and livestock, while also increasing participation of women and youth. In its first phase (2010-2015), programme coverage was 96 woredas in four regions (Amhara, Oromia, Tigray and SNNPR), reaching approximately 2.2 million households. In its second phase (AGP II, 2016-2020) will extend to include four additional regions of Gambella, Benishangul-Gumuz, Harari and Dire Dawa; planned number of woredas is 157. AGP I had an objective to improve nutritional status, to be accomplished through crop production, which by itself is not likely to be adequate. AGP II will not have major changes in design, but will include nutrition as a cross cutting issue and increase focus on small-scale farmers. The programme document is still in draft, but should include an outcome indicator of increased dietary diversity, thus allowing for greater accountability to nutrition sensitivity.

An evaluation of AGP I found that mainstreaming nutrition activities into agriculture (i.e. increasing nutrition sensitivity) should use current opportunities, including use of the multi sector NNP structures, establishment of a nutrition focus within the agriculture extension services (DAs), use of the WDA network for widespread knowledge dissemination and HEW-DA linkage at Farming Training Centres (FTCs) for combined practical demonstration and knowledge sharing.

Observations from field study. Coverage of the AGP is moderate, reaching only agrarian regions as intended in the programme design. In agrarian regions where the programme is present, coverage of agriculture production interventions is high. However, coverage of nutrition sensitive (nutrition and agriculture linked) interventions (such as home gardening of diverse foods, homestead poultry) is variable with some woredas having greater coverage than others (e.g. all vs. less than half of kebeles), often dependent on rollout of programme or partner support for implementation. Participation in nutrition sensitive agriculture is moderate, with households not always able to participate due to lack of implementation capacity for the activities, e.g. home gardens and/or animal rearing.

ⁱⁱ Intervention area: nutrition-sensitive agriculture; livelihood

Resource intensity at local level could not be assessed. Targeting of AGP activities is not specific to nutrition, instead focused on potential for increasing crop production, unless the woreda has received NNP rollout (nutrition sensitive interventions may be implemented). In support of the overall AGP strategy, activities are being designed to target households vulnerable to malnutrition, making agriculture more directly relevant to nutrition.

The content of AGP I is not sufficient to meet its own objective of improving nutritional status, as this was to be done through crop production. If AGP II includes an indicator of improving dietary diversity, it is possible that improving nutritional status will be met, which is in line with overall nutrition objectives. However, this will not be accomplished unless coupled with multi sector work to provide education and practical training for improving consumption of diverse foods.

As an umbrella agriculture programme, nutrition relevance is limited. Relevance will be improved if activities are nutrition sensitive and targeted to vulnerable groups (PLW, under-2 children).

Empowering New Generations in Improved Nutrition and Economic opportunities (ENGINE)^{jj}

ENGINE is an integrated nutrition programme, aimed to improve nutritional status of women and under-2 children. Community level implementation includes maternal, neonatal and child health and nutrition interventions (e.g. CMAM, micronutrient supplementation, IYCF counselling), WASH activities, capacity building of HEWs and agricultural development agents (ADAs), community mobilization (especially through the HDA networks) and SBCC. Agricultural interventions are provided for livelihood support and income generation, and are coupled with counselling on consumption of foods and/or livestock produced. The project operates in productive, i.e. AGP, woredas for the most part, covering targeted kebeles within 83 woredas in four regions (Amhara, Oromia, Tigray, SNNPR). Within each woreda, two kebeles are targeted for nutrition sensitive livelihood interventions, with a maximum of the 50 most vulnerable households receiving interventions from the project. ENGINE will soon expand to include 17 woredas in Somali through a mechanism similar to Milk Matters, supporting increased production of milk for consumption, coupled with SBCC for IYCF.

An external performance evaluation of ENGINE was conducted in 2014 to assess progress towards achieving three of the programme's intermediate results (IR) areas: strengthened capacity for and institutionalization of nutrition programmes and policies; improved quality and delivery of nutrition and health care services; improved prevention of undernutrition through community based nutrition care practices. The evaluation found that ENGINE was on track to meet targets for these IRs (1-3), and specifically had major impact on strengthening national, zonal and woreda-level multisectoral systems for scale up on nutrition activities.

^{jj} Intervention area: nutrition sensitive agriculture, community based programme

Prioritization of activities in areas related to stunting in Ethiopia (e.g. WASH, food security, dietary diversity) was found to be needed to ensure achievement of project impact. Also, there is a lack of clear understanding of how ENGINE activities lead to nutrition and food security impact among target groups, and how the project can be scaled up.⁶

Observations from field study. Overall coverage of ENGINE activities is moderate, limited to productive woredas in agrarian regions as per project design, and to the initiation of interventions similar to Milk Matters in a few pastoral woredas. Some woreda level interventions have high coverage; these include support for capacity building of community level health workers, Social and Behavioural Change Communication (SBCC) and support to interventions within the HEP with the exception of GMP and CMAM and CHD supply provision. Coverage of nutrition sensitive interventions targeted to households is low, as only two kebeles per woreda are designated for project intervention. Participation is low as well, with only households meeting criteria for intervention receiving support (maximum 50 households per kebele).

Resource intensity at the local level is unknown. Targeting of activities toward undernutrition is present, as the most vulnerable households with PLW and/or under-2 children receive interventions. Indicators of undernutrition are not used as criteria for project eligibility, but the households identified for agriculture interventions (e.g. homestead gardens, poultry) are more vulnerable to undernutrition among women and children due to for example, lack of livelihood, limited market access, etc. At local level, the project is designed to meet its objective of improving nutritional status of women and under-2 children through livelihood interventions that aim to increase home production and consumption of diverse foods (including animal foods) and linkage to markets for selling of excess production. These objectives are also in line with general objectives of improving nutritional status.

Productive Safety Net Programme (PSNP)^{kk}

As a social protection programme, the goal of the PSNP is to improve household food security. In the first three phases (2005-2014), 80% of beneficiaries received either food or cash in exchange for public works while 20% of direct beneficiaries received support without participation in public works (including PLW). The fourth phase aims to cover all regions except Gambella and Benishangul-Gumuz by 2020 (eight regions covered in the first phases), with an annual caseload of 10 million individuals, of which 8.3 million are chronically food insecure.

In PSNP woredas, GMP should also be present (by GMP programme design), to provide a link to community based nutrition programming for preventative care for PSNP beneficiaries. In its fourth phase (2015-2020) the programme will become more nutrition oriented by targeting individuals, offering extended direct support for PLW and caretakers of children with severely malnourished children and including nutrition-related conditionalities (e.g. ANC attendance, GMP participation, IYCF counselling, etc.), similar to other Conditional Cash Transfer Programmes.⁷⁻⁹ Objectives for nutrition improvements include indicators of improved nutritional status in programme areas; 6-23 month children who receive the minimum acceptable diet; and

^{kk} Intervention area: safety net, social protection

adequate knowledge, attitude and practice of nutrition-related behaviours. Evaluations of the first three phases of PSNP demonstrate a two-month improvement in food security, but lack of improvement in quality of children's diets (6-24 months) or outcomes of nutritional status (stunting, wasting, underweight and corresponding z-scores).¹⁰ These findings provided impetus for making the next phase of PSNP more nutrition oriented.

Observations from field study. Coverage of PSNP at local level is moderate as per design, defining food insecure woredas as those in need of the programme. Within woredas designated to receive PSNP support, coverage is high as all kebeles receive PSNP activities. Participation is also high at kebele level, though could be moderate to low if the need in one woreda greatly exceeds that of the programme funding. Resource intensity at the local level could not be assessed. Targeting of PSNP interventions toward undernutrition occurred in a limited manner in its first three phases, essentially only allowing direct support for PLW for a limited period of time. In woredas where the TSF programme was previously present, local administrators were using the contingency PSNP budget to provide support to PLW with moderate acute malnutrition, thus improving targeting at the local level.

Previous PSNP phases were successful in meeting the goal of improving food security, but not to meet the objective of improving nutritional status. In the coming phase, the programme objectives will be more in line with nutrition objectives, aiming to improve not only nutritional status, but also dietary diversity, and nutrition-related behaviours.

Thus although nutrition relevance was limited in first phases, this will greatly improve in the fourth phase with targeting of individuals, providing extended direct support with conditions for PLW and caretakers of children with SAM, for improving nutrition related behaviours

Additional observations

A common theme found among all projects assessed and woredas visited was the need for enhanced capacity for implementation of nutrition activities. Partners supporting interventions of the Government's NNP were instrumental in providing capacity building of workers in health and other sectors. In historically food insecure woredas, where the presence of assistance organizations tended to be greatest, nutrition capacity of community workers was greater than in areas of relative food security, i.e. less support resulted in decreased nutrition capacity.

A considerable amount of nutrition information is collected and available for use at the community level. However, most data is used solely for reporting purposes and sent to the woreda level without community assessment. There is a critical lack of understanding of nutrition information, inhibiting real time monitoring of implementation and outcomes at kebele level to allow for adjustments to address needs.

Programme and sector resources needed and available

Some rough estimates can be made, from these studies combined with the donor resource data (section 3b), of the resources used, including scaling up to very approximate numbers for what might be needed at national level. In addition, the 2013 donor commitment in these areas can be added in. Results are shown in table 3.24.

The WASH estimates are available from official resources, and these need to be compared. It appears that a \$2.4 billion programme is envisaged, with about half going to rural areas; this makes our figure at least in the same range.

We note in section 3c below that few donor-supported agricultural projects are oriented towards explicitly (or usually implicitly too) affecting child nutrition. This seems in line with the field studies – and it should be stressed that orienting to nutrition is not usually effective through adding components of home production.¹¹ Thus the donor (and probably GoE) resources for agriculture –considerably less than the health sector (\$649 million in 2013, see section 3b) – will need specific changes to have an impact on nutrition.

Community nutrition itself is known elsewhere to cost around \$10/child/year to be effective,¹² and this figure is used (rather than the low estimate for A&T). The donor contribution to nutrition of \$60 million seems to be approaching the needed level (say \$180 million), considering that only half the children are participating in community nutrition (CBN and others).

For PSNP, which is highly relevant to nutrition, we need more information on resources. In their absence, we can draw upon income data to make some guesses. As shown in section 2 c and from the World Bank website,¹³ around \$500/year represents average income, and \$300/head expenditure. If, for example, PSNP had to give income support to 10% of the population for 25% of the time, this amounts to around \$0.5 billion per year; this is similar to the results we get from conditional cash transfer programmes, usually running at \$20-30/recipient household per year (here calculated for 10% of the population). Targeting these resources to the malnourished could make a big impact on nutrition.

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Section 3. Needs relative to programmes

3.A Mapping – Tables and Figures

WASH program need

Anthropometry

Figure 3.1.

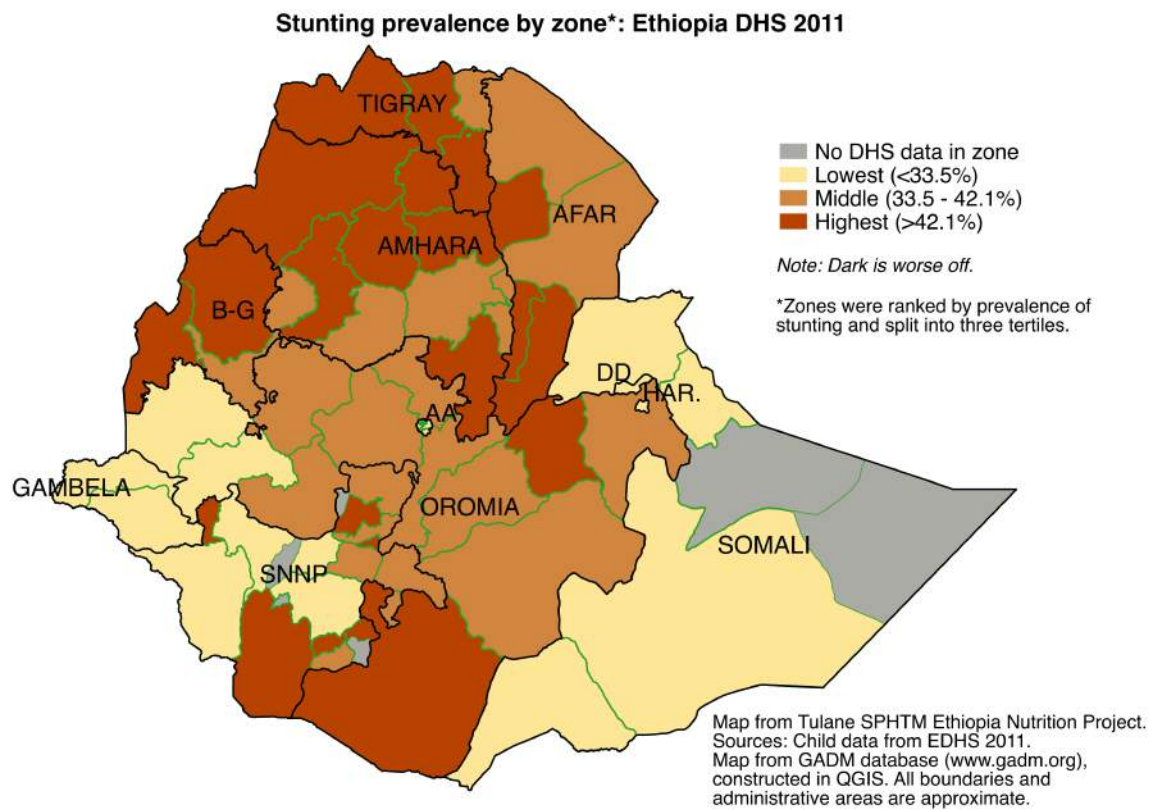


Figure 3.2.

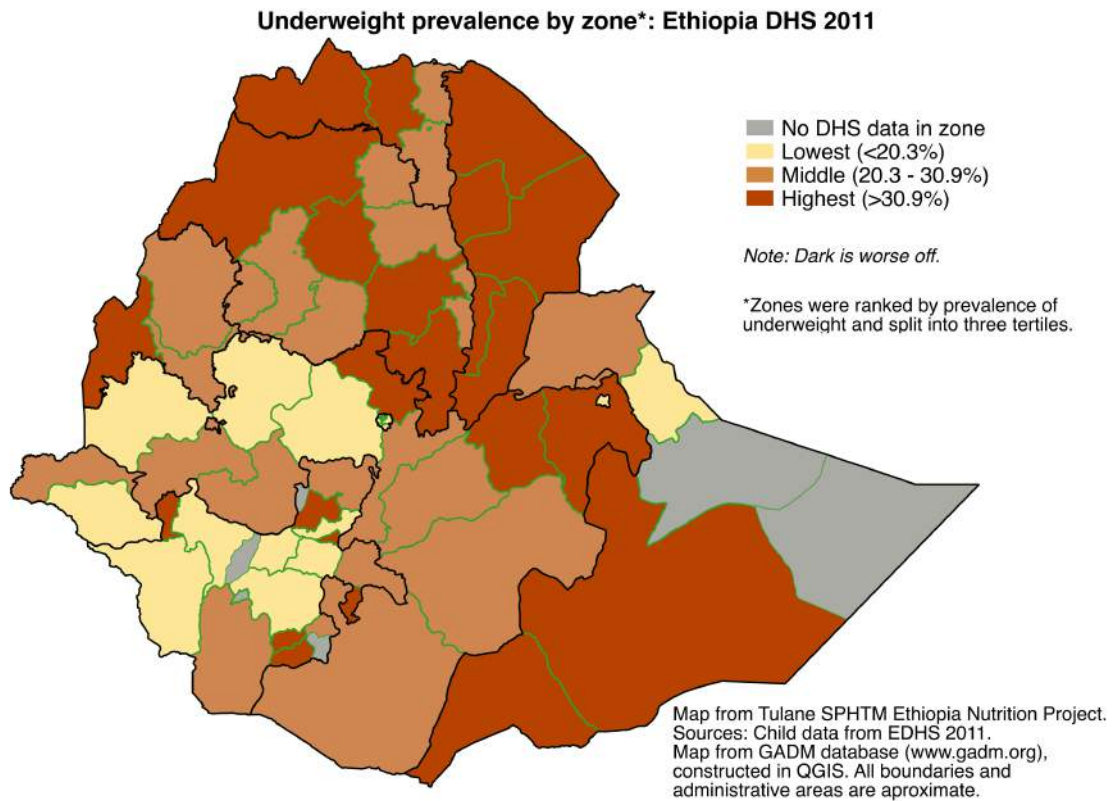
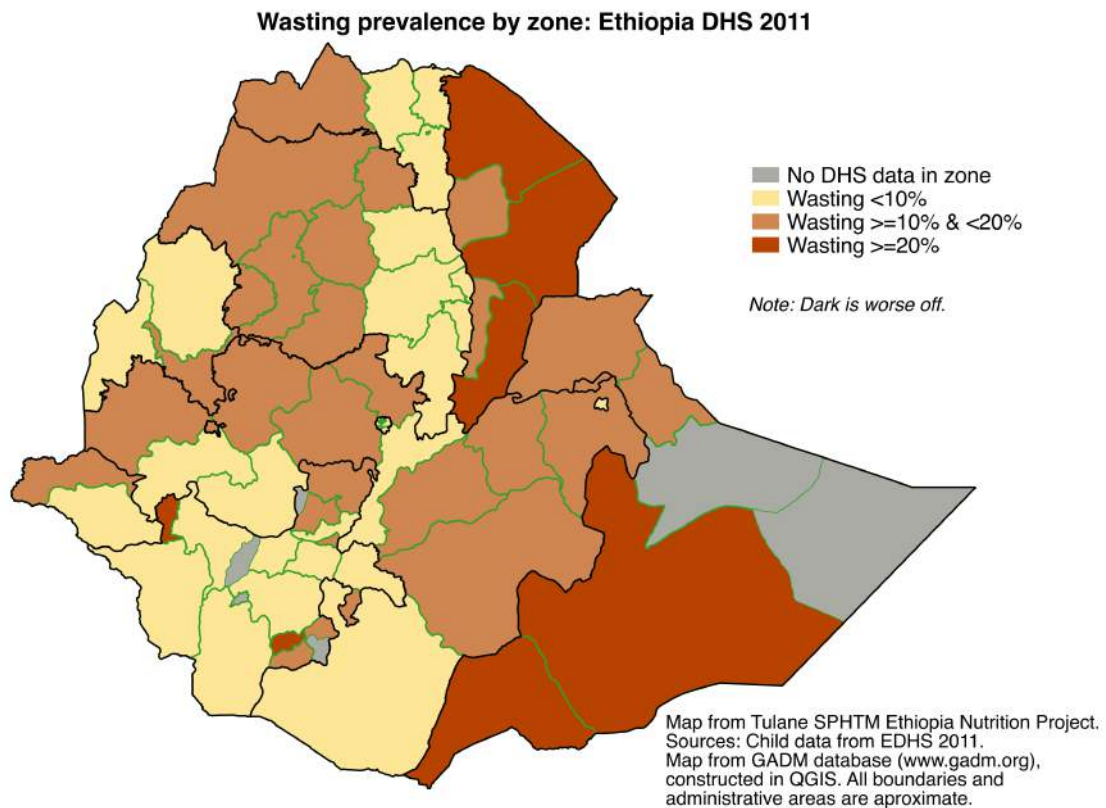


Figure 3.3.



WASH program need based on poor drinking water

Figure 3.4.

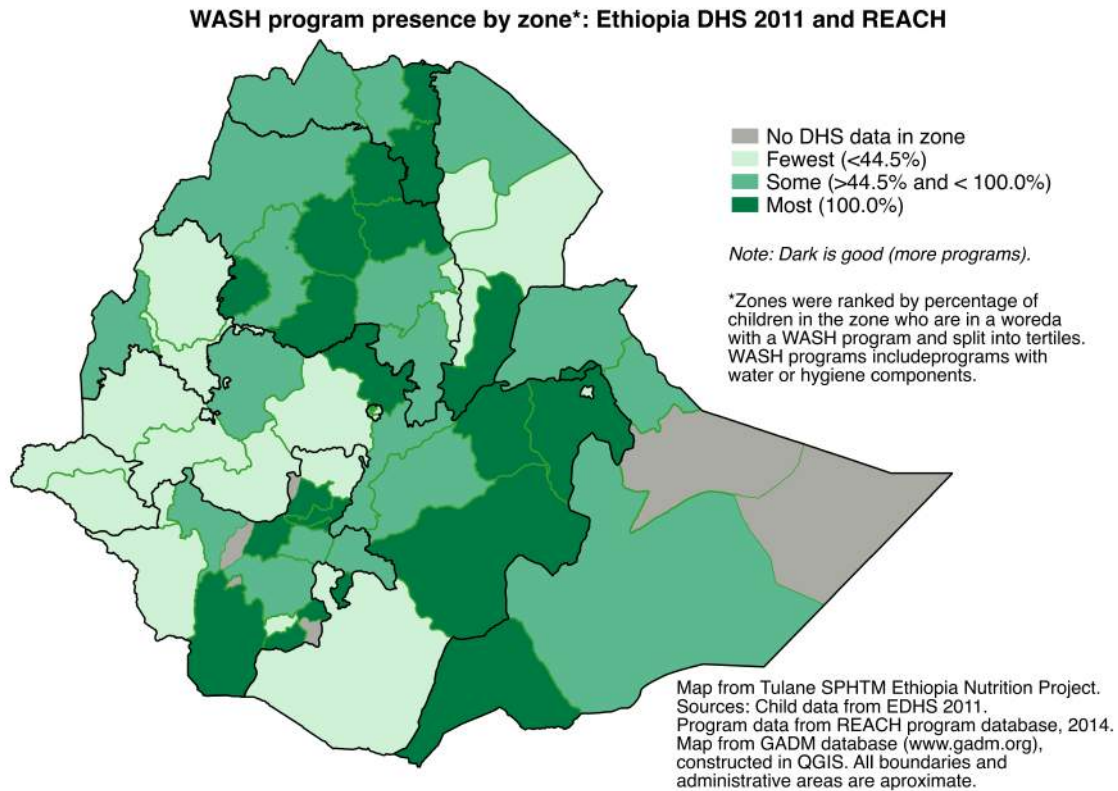


Figure 3.5.

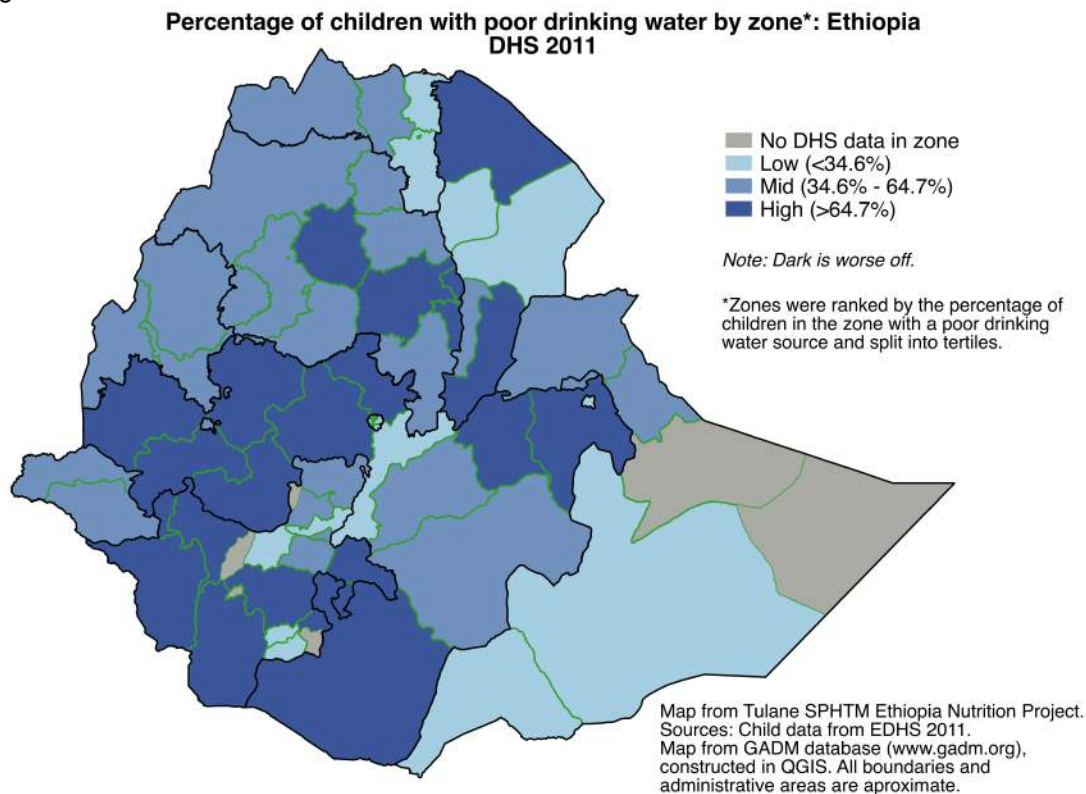


Figure 3.6.

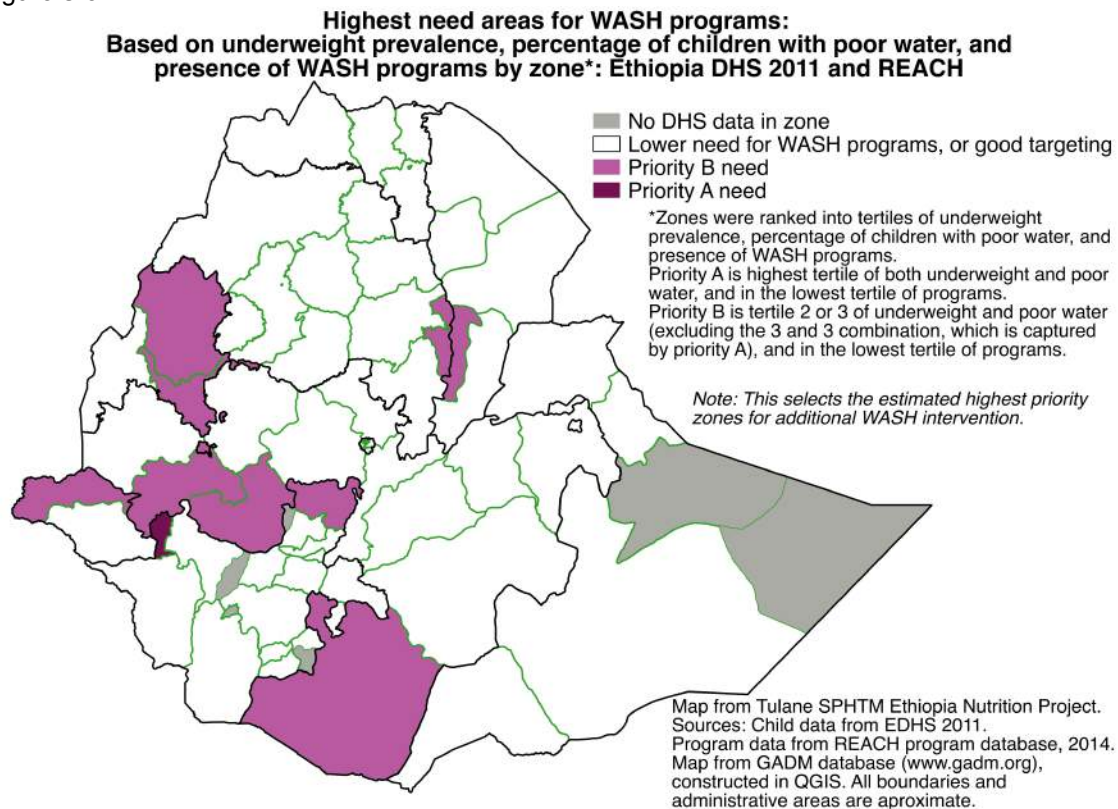


Figure 3.7.

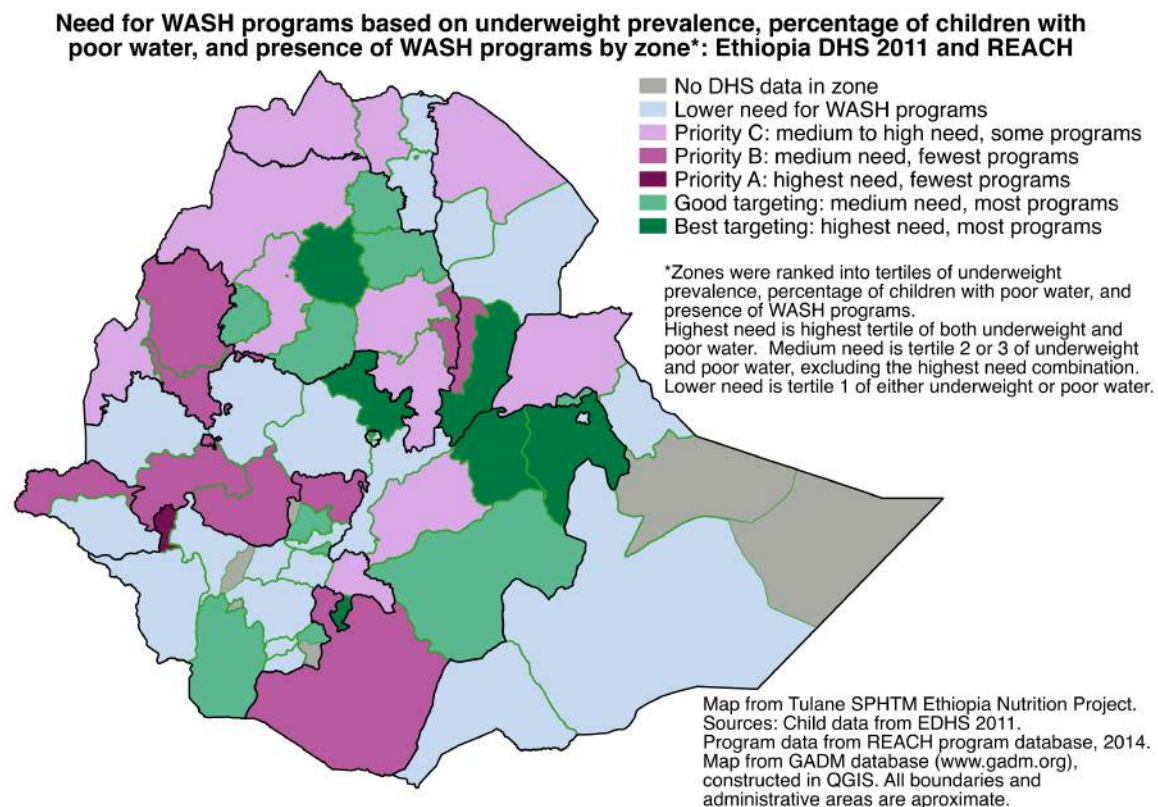


Table 3.1. Summary of need and targeting of safe water programs based on: underweight prevalence, percentage of children in zone with poor water, and presence of WASH programs.

In cells: priority or targeting type, number of zones.

		Need: based on prevalence of underweight & percentage of children with poor water		
		Highest Need ^a	Medium Need ^b	Low Need ^c
WASH Program Presence	Fewest	Priority A 1 zones ^d	Priority B 9 zones ^e	12 zones
	Some	Priority C 11 zones		9 zone
	Most	Best Targeting 6 zones	Good Targeting 9 zones	9 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children with a poor water source.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children with a poor water source. This excludes the zones in tertile 3 of both prevalence and poor water as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children with a poor water source. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (WASH programs).

^d Priority A zones:

SNNP: Shaka (However, fewer than 30 un-weighted cases)

^e Priority B zones:

Afar: Zone 5

Amhara: Oromia Zone

Benishangul-Gumuz: Kemashi, Metekel

Gambela: Zone 1

Oromia: Borena, Ilu Babor, Jimma

SNNP: Guraghe

Table 3.2. Number of zones by tertile of: underweight prevalence, percentage of children with poor water, and presence of WASH programs.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
Poor water source ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
WASH Programs ^c	Fewest	1	1	3	4	4	0	3	1	5	22
	Some	2	5	1	1	3	1	3	2	2	20
	Most	6	1	2	2	6	2	0	0	5	24
Totals		9	7	6	7	13	3	6	3	12	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3% < prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone with poor drinking water source and split into tertiles: high is poor water > 64.7%, mid. is 34.6% < poor water < 64.7%, low is poor water < 34.6%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with a WASH program, then split into tertiles: fewest WASH programs is 0% to 44.6%, some is 44.6% to <100.0%, most is 100.0%.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for WASH programs (based on poor water)

WASH program need based on no toilet

Figure 3.8.

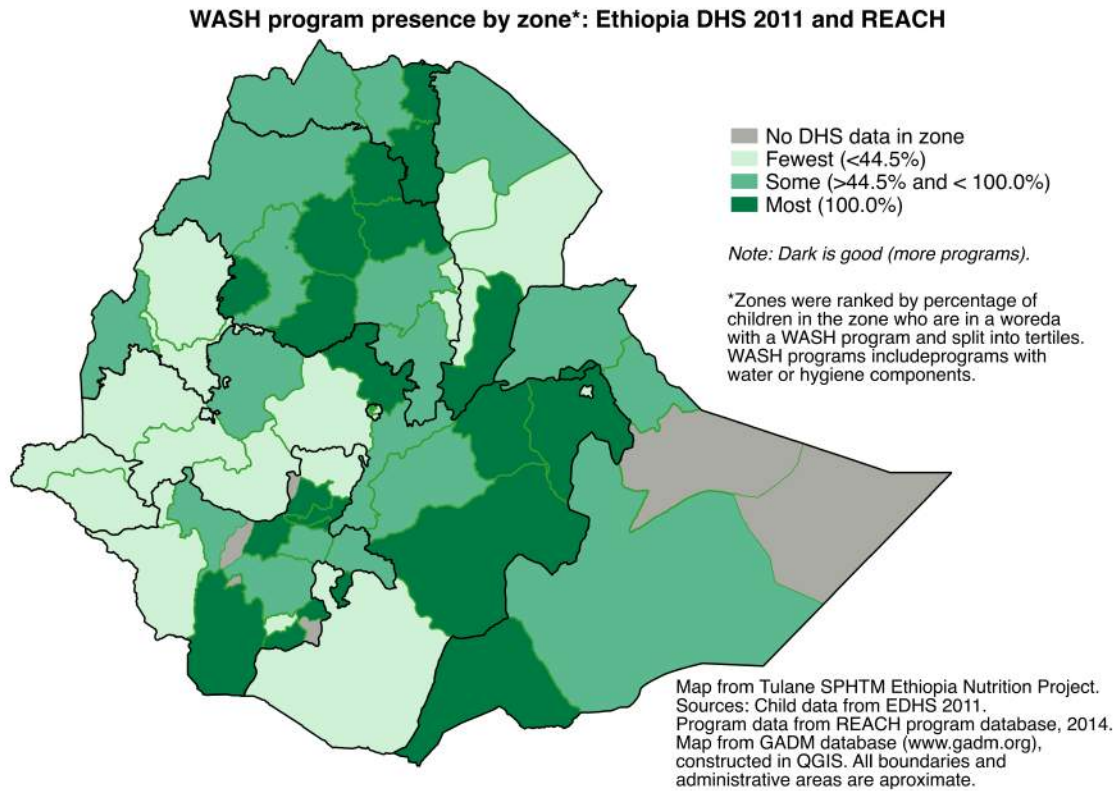


Figure 3.9.

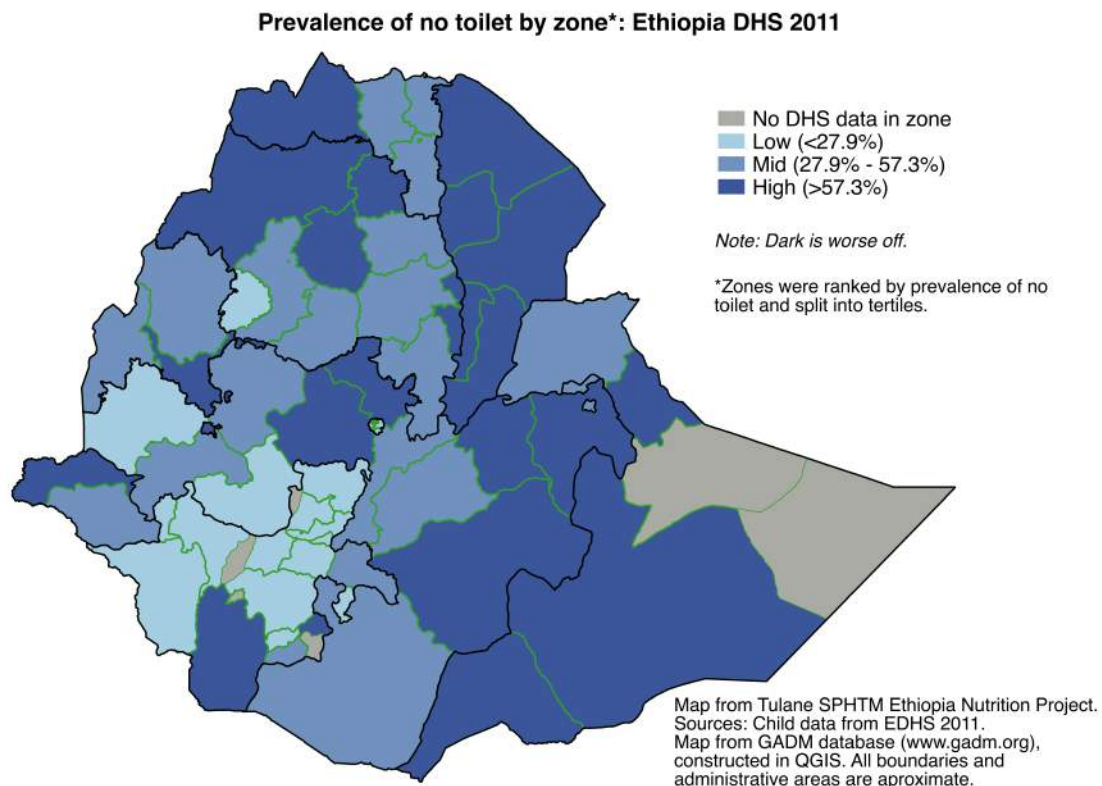


Figure 3.10.

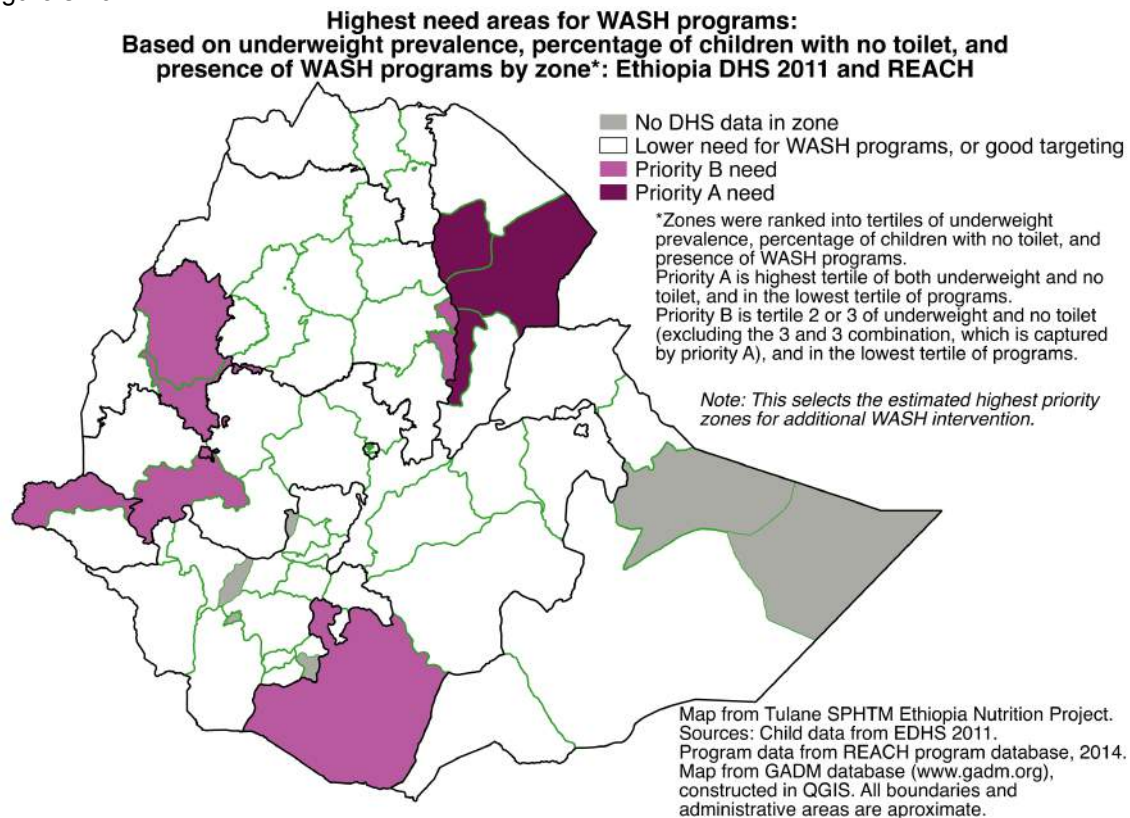


Figure 3.11.

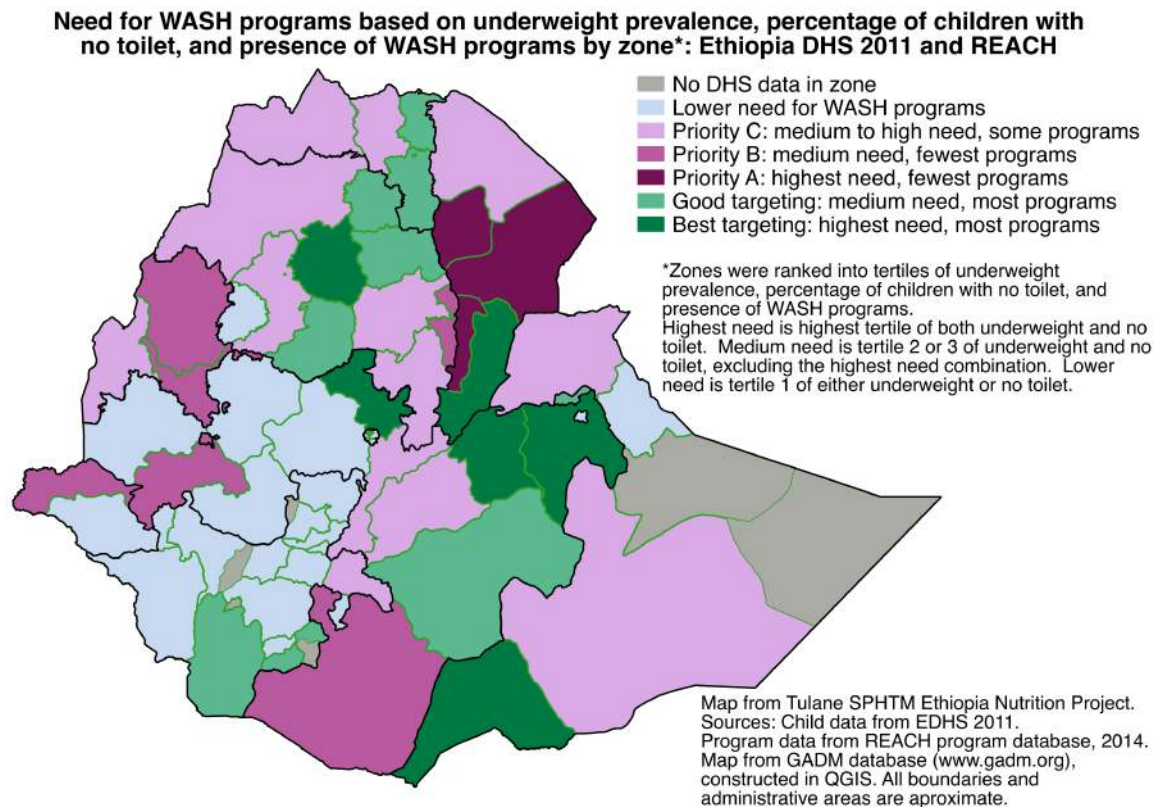


Table 3.3. Summary of need for, and presence of WASH programs based on underweight prevalence, percentage of children in zone with no toilet, and presence of WASH programs.

In cells: priority or targeting type (none=low priority), number of zones.

		Need: based on prevalence of underweight & percentage of children with no toilet		
		Highest Need ^a	Medium Need ^b	Low Need ^c
WASH Program Presence	Fewest	Priority A 3 zones ^d	Priority B 6 zones ^e	13 zones
	Some	Priority C 13 zones		7 zone
	Most	Best Targeting 6 zones	Good Targeting 10 zones	8 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children with no toilet.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children with no toilet. This excludes the zones in tertile 3 of both prevalence and no toilet as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children with no toilet. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (WASH programs).

^d Priority A zones:

Afar: Zone 1, Zone 4, Zone 5

^e Priority B zones:

Amhara: Oromia Zone

Benishangul-Gumuz: Kemashi, Metekel

Gambela: Zone 1

Oromia: Borena, Ilu Babor

Table 3.4. Number of zones by tertile of underweight prevalence, percentage of children with no toilet, and presence of water programs.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
No Toilet ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
WASH Programs ^c	Fewest	3	0	2	3	3	2	1	3	5	22
	Some	4	4	0	0	5	0	1	1	5	20
	Most	6	1	2	4	5	1	0	0	5	24
Totals		13	5	4	7	13	3	2	4	15	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3%< prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone with no toilet and split into tertiles: high is no toilet > 57.3%, mid. is 27.9% < no toilet < 57.3%, low is no toilet < 27.9%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with a WASH program, then split into tertiles: fewest WASH programs is 0% to 44.6%, some is 44.6% to <100.0%, most is 100.0%.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for WASH programs (based on no toilet)

Water (WASH component) program need based on poor drinking water

Figure 3.12.

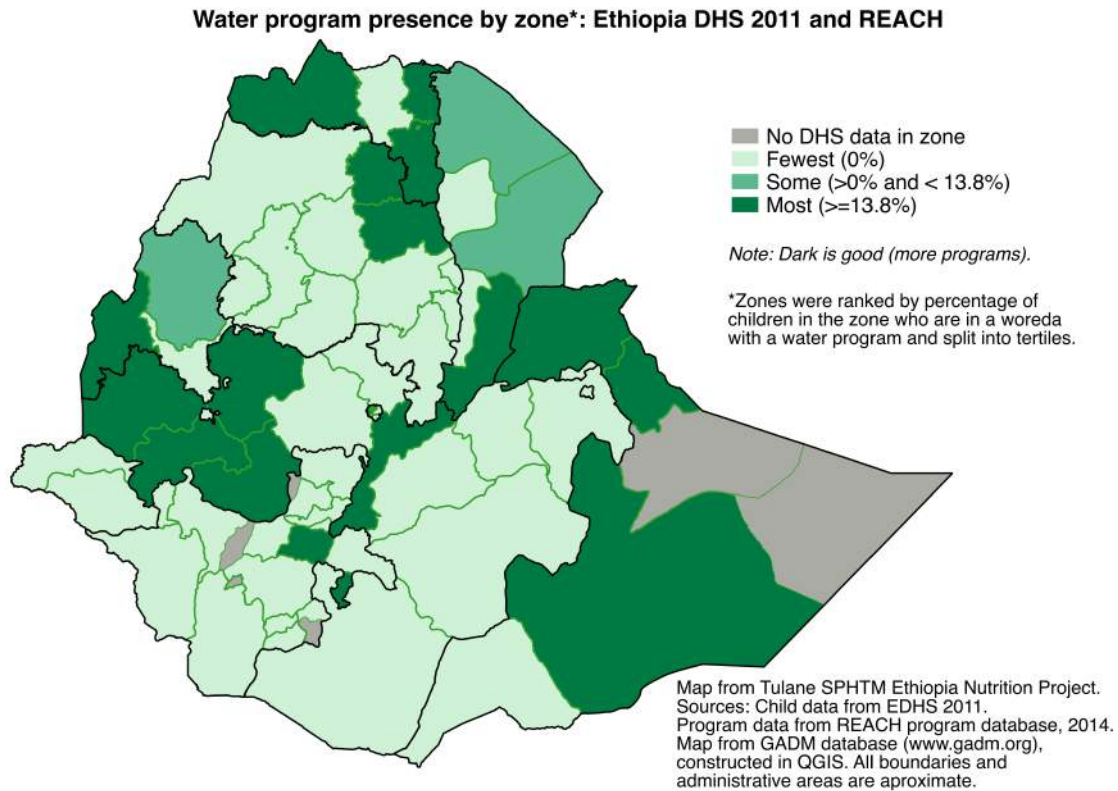


Figure 3.13.

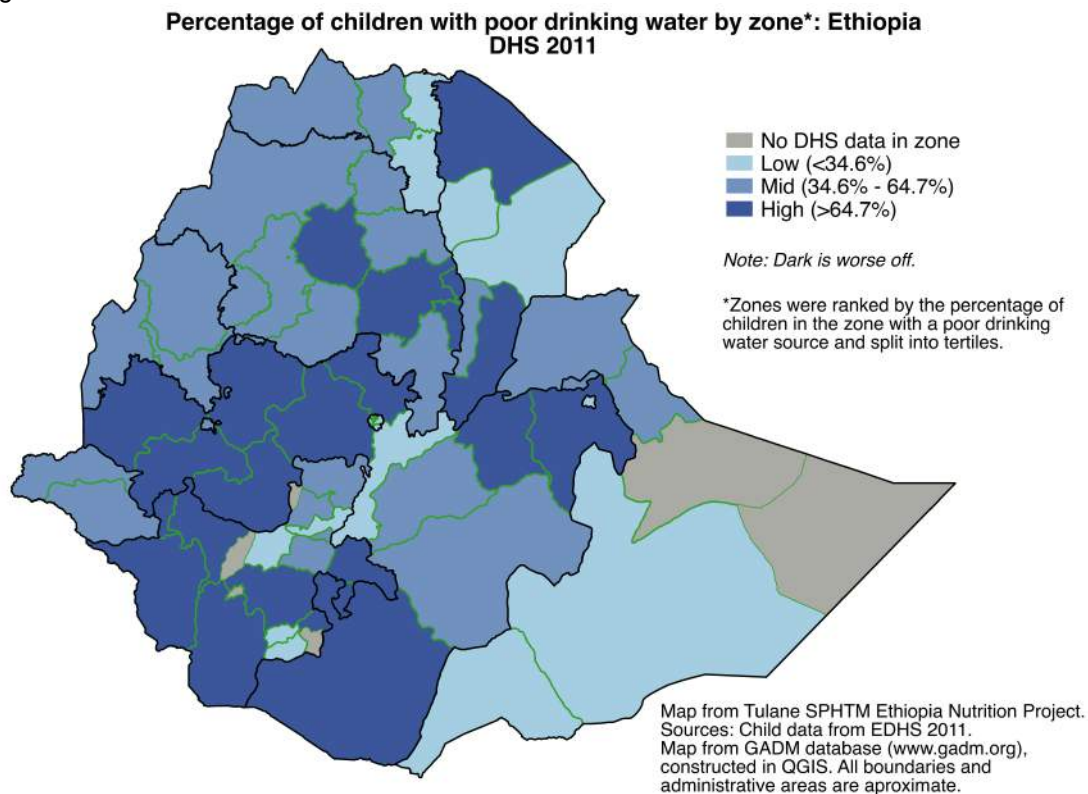


Figure 3.14.

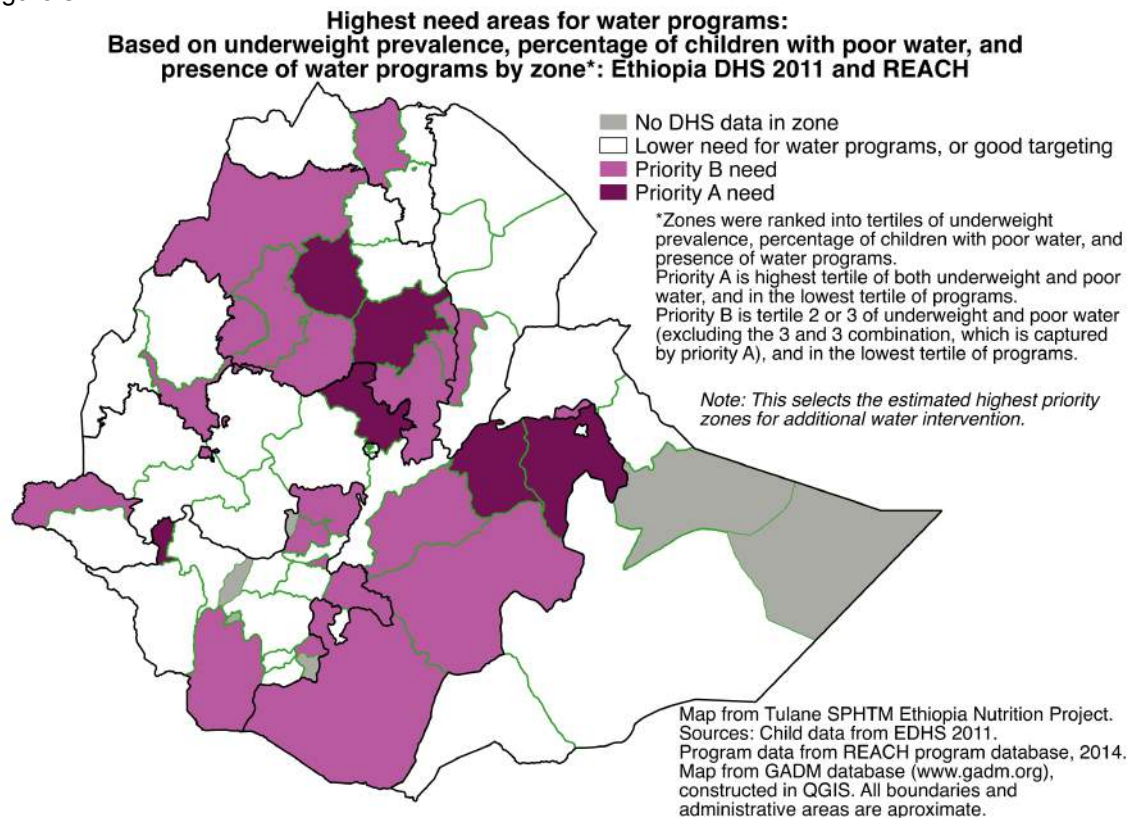


Figure 3.15.

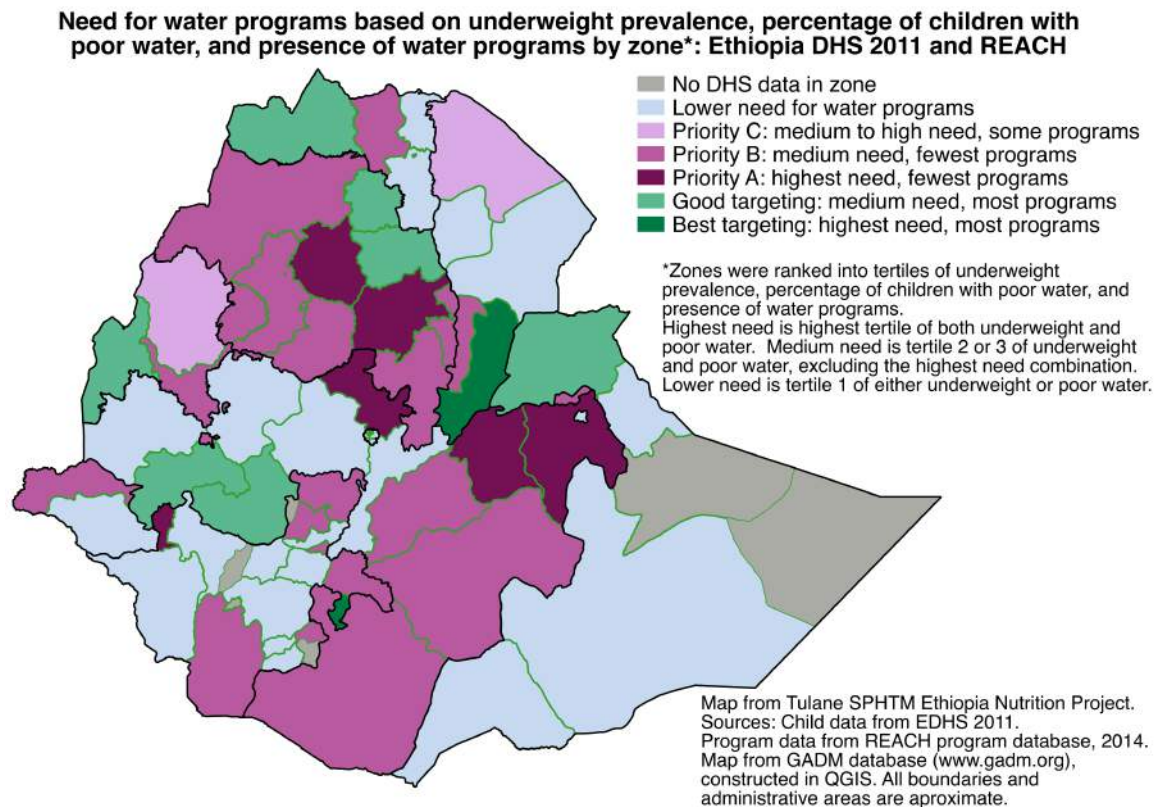


Table 3.5. Summary of need for, and presence of safe water programs based on underweight prevalence, percentage of children in zone with poor water, and presence of water programs.

In cells: priority or targeting type, number of zones.

		Need: based on prevalence of underweight & percentage of children with poor water		
		Highest Need ^a	Medium Need ^b	Low Need ^c
Water Program Presence	Fewest	Priority A 6 zones ^d	Priority B 19 zones ^e	16 zones
	Some	Priority C 2 zones		1 zone
	Most	Best Targeting 2 zones	Good Targeting 7 zones	13 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children with a poor water source.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children with a poor water source. This excludes the zones in tertile 3 of both prevalence and poor water as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children with a poor water source. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (increased access to safe water).

^d Priority A zones

Amhara: South Gonder, South Wollo
Oromia: East Harerghe,
North Shewa, West Harerghe
SNNP: Shaka

^e Priority B zones

Afar: Zone 5
Amhara: Awi, East Gojam,
North Gonder, North Shewa,
Oromia Zone, West Gojam
Beneshangul-Gumuz: Kemashi
Dire Dawa: Dire Dawa

Gambela: Zone 1
Oromia: Arsi, Bale, Borena
SNNP: Amaro Special,
Guraghe, Hadiya
Sidama, South Omo
Tigray: Central Tigray

Table 3.6. Number of zones by tertile of underweight prevalence, percentage of children with poor water, and presence of water programs.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
Poor water source ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
Water Programs ^c	Fewest	6	5	4	5	9	0	4	1	7	41
	Some	1	0	1	0	1	0	0	0	0	3
	Most	2	2	1	2	3	3	2	2	5	22
Totals		9	7	6	7	13	3	6	3	12	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3% < prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone with poor drinking water source and split into tertiles: high is poor water > 64.7%, mid. is 34.6% < poor water < 64.7%, low is poor water < 34.6%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with a program that provides safe drinking water, then split into tertiles: fewest water programs is 0% of children in the zone are in a woreda with a water program (more than 1/3 of the zones had no presence of water programs), some is > 0% and < 13.8%, most is > 13.8%.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for water programs

Hygiene (WASH component) program need based on no toilet

Figure 3.16.

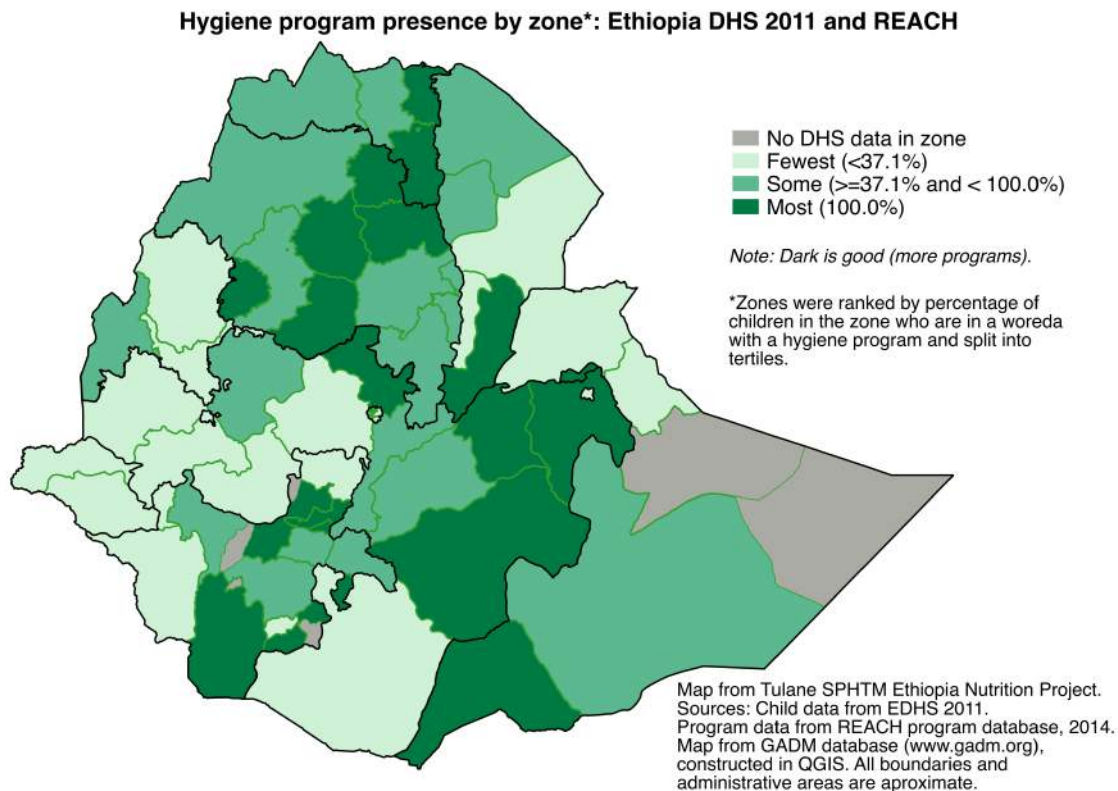


Figure 3.17.

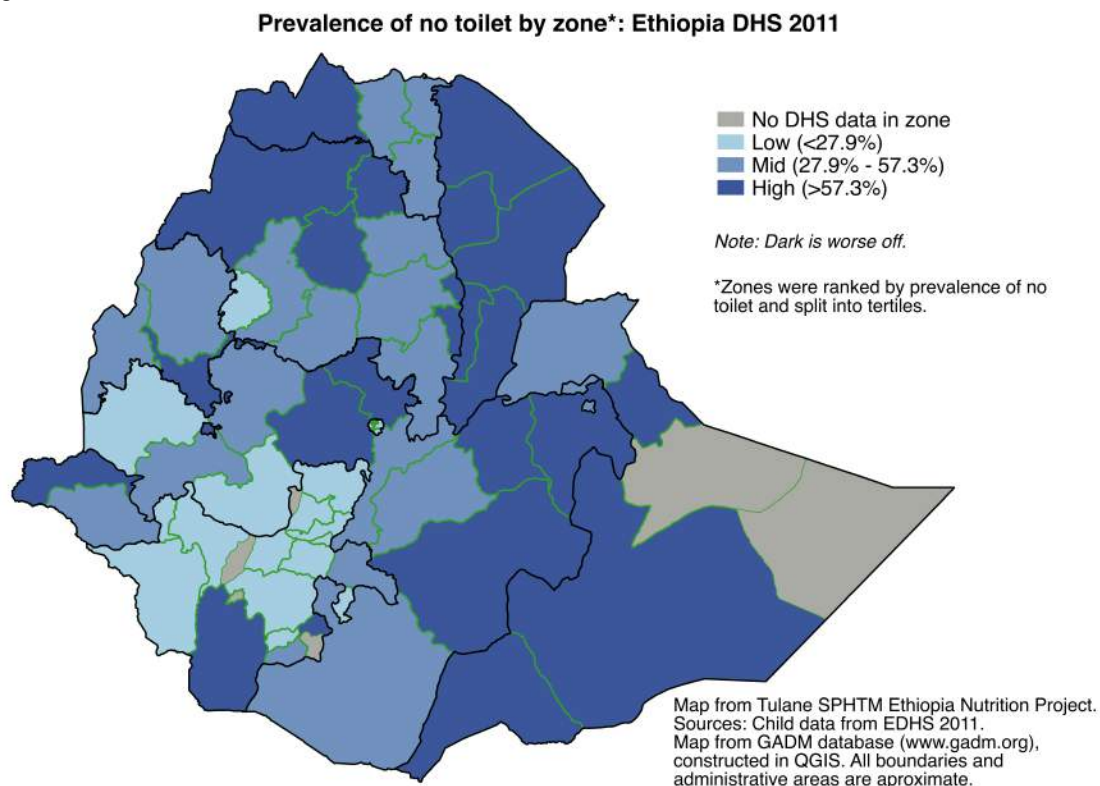


Figure 3.18.

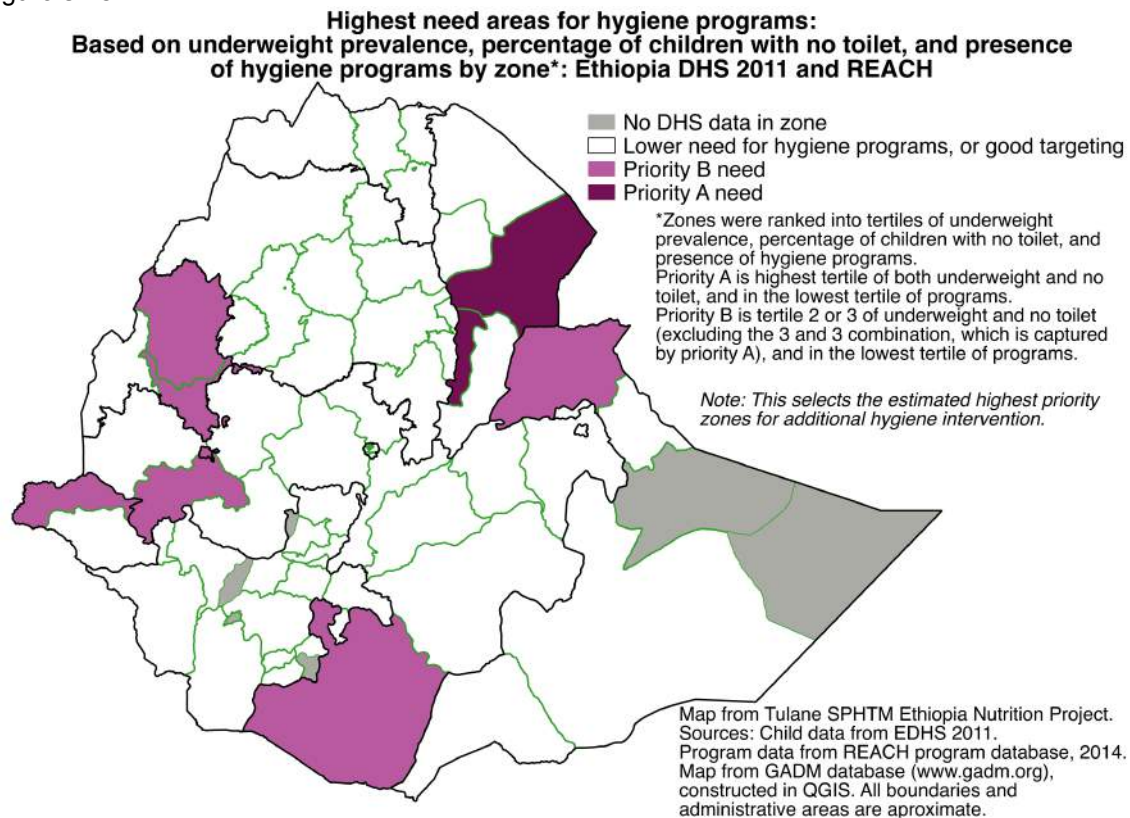


Figure 3.19.

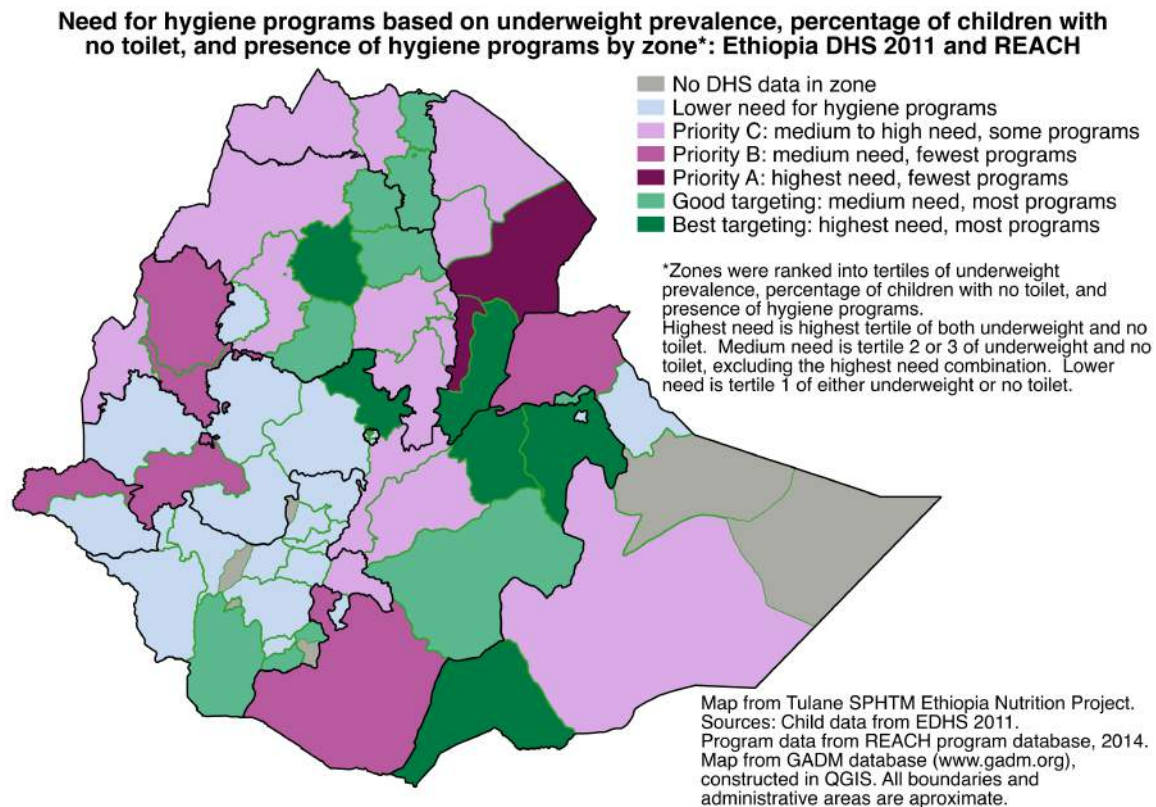


Table 3.7. Summary of need for, and presence of hygiene programs based on underweight prevalence, percentage of children in zone with no toilet, and presence of hygiene programs.

In cells: priority or targeting type, number of zones.

		Need: based on prevalence of underweight & percentage of children with no toilet		
		Highest Need ^a	Medium Need ^b	Low Need ^c
Hygiene Program Presence	Fewest	Priority A 2 zones ^d	Priority B 6 zones ^e	14 zones
	Some	Priority C 13 zones		6 zone
	Most	Best Targeting 6 zones	Good Targeting 10 zones	8 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children with a no toilet.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children with no toilet. This excludes the zones in tertile 3 of both prevalence and no toilet as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children with no toilet. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (hygiene programs).

^d Priority A zones

Afar: Zone 1, Zone 5

^e Priority B zones

Beneshangul-Gumuz: Kemashi, Metekel

Gambela: Zone 1

Oromia: Borena, Ilu Babor

Somali: Shinileg

Table 3.8. Number of zones by tertile of underweight prevalence, percentage of children with no toilet, and presence of hygiene programs.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
No toilet ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
Hygiene Programs ^c	Fewest	2	0	2	2	4	2	2	3	5	41
	Some	5	4	0	1	4	0	0	1	5	3
	Most	6	1	2	4	5	1	0	0	5	22
Totals		9	7	6	7	13	3	6	3	12	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3% < prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone with no toilet and split into tertiles: high is no toilet > 57.3%, mid. is 27.9% < no toilet < 57.3%, low is no toilet < 27.9%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with a hygiene program, then split into tertiles: fewest hygiene programs is 0% to 37.1%, some is 37.1% to <100.0%, most is 100.0%.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for hygiene programs

PSNP

Anthropometry (repeated)

Figure 3.20.

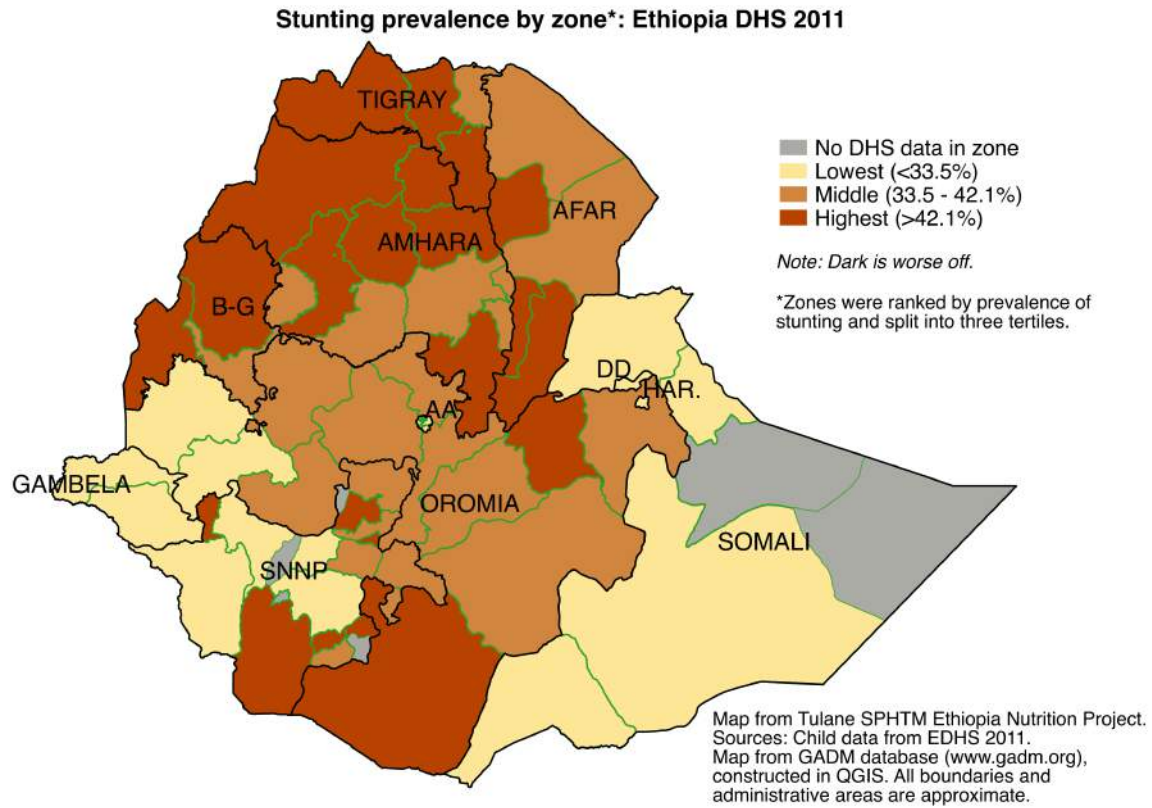


Figure 3.21.

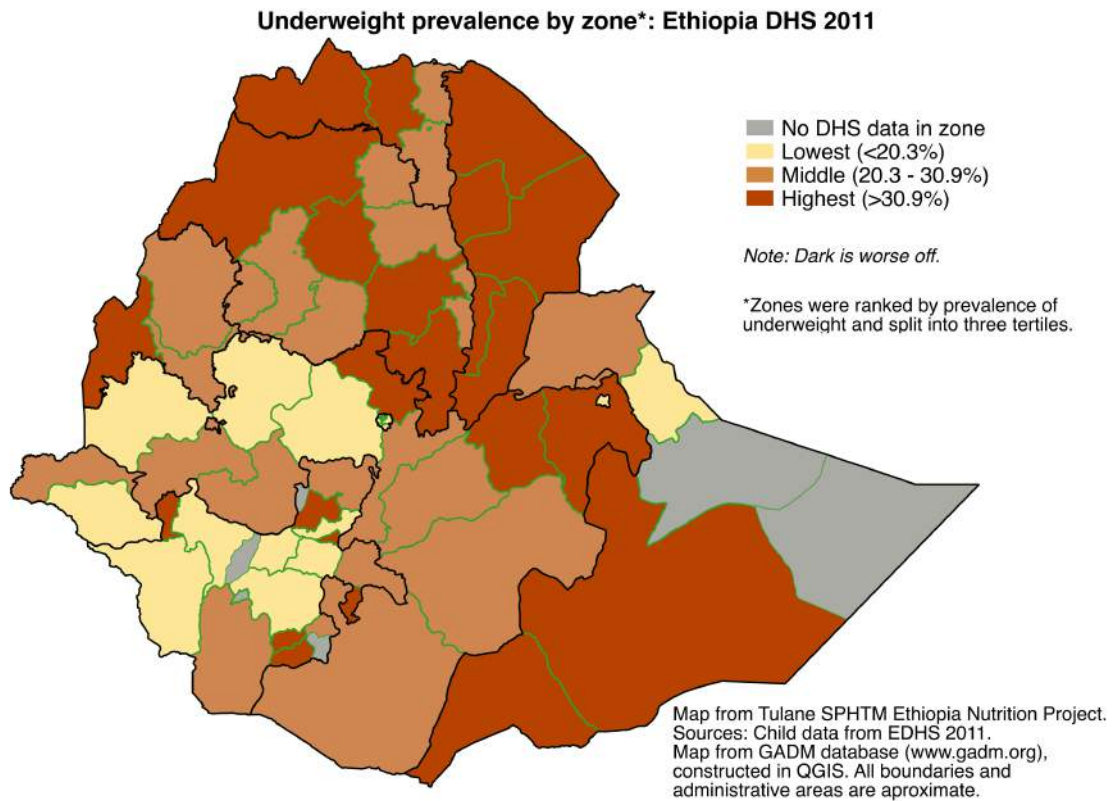
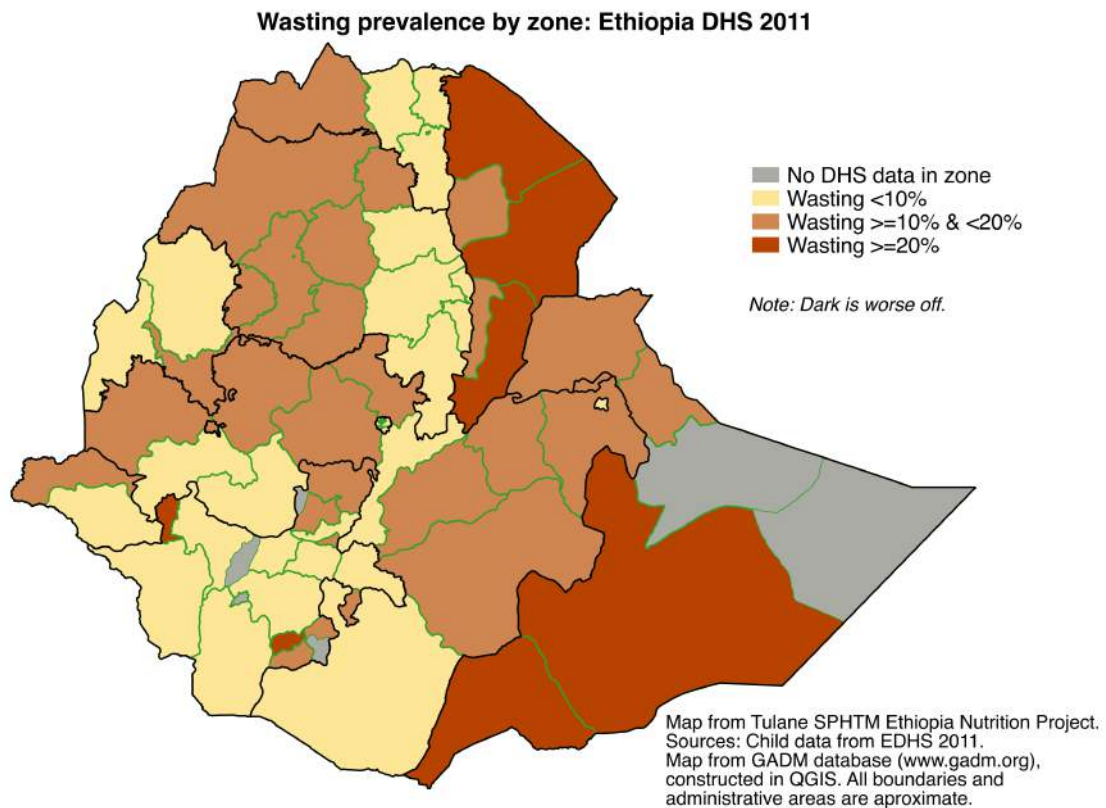


Figure 3.22.



PSNP program need

Figure 3.23.

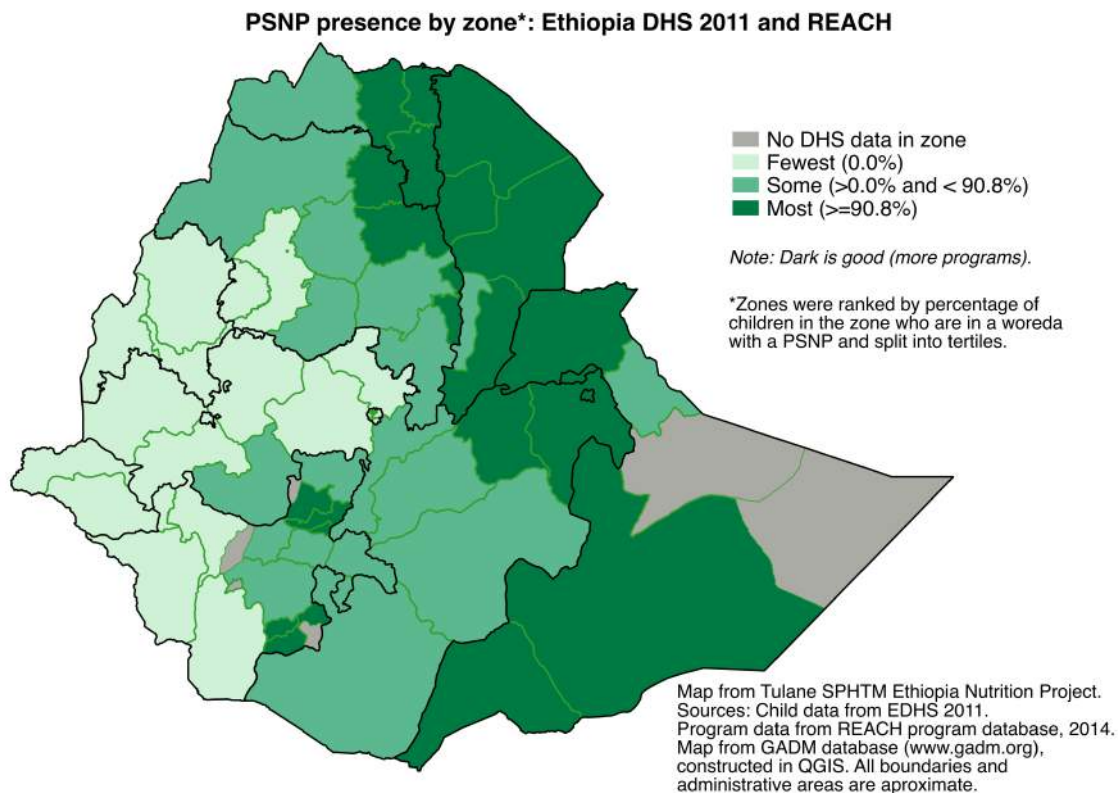


Figure 3.24.

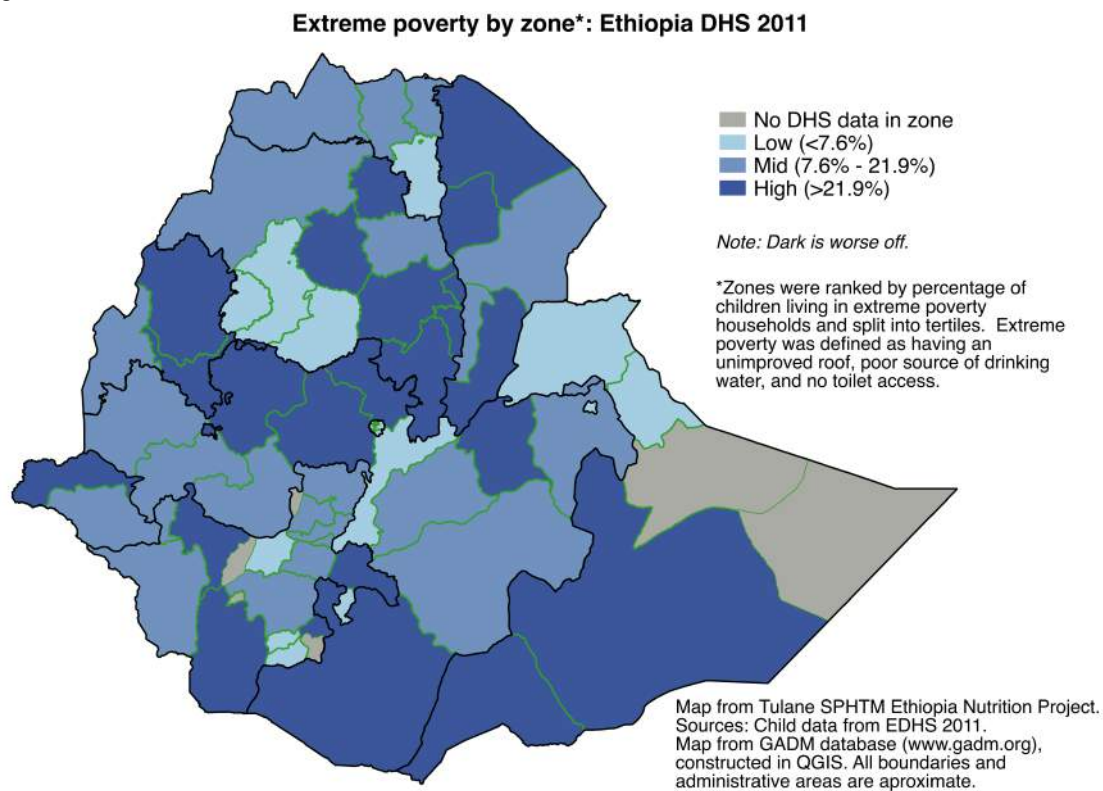


Figure 3.25.

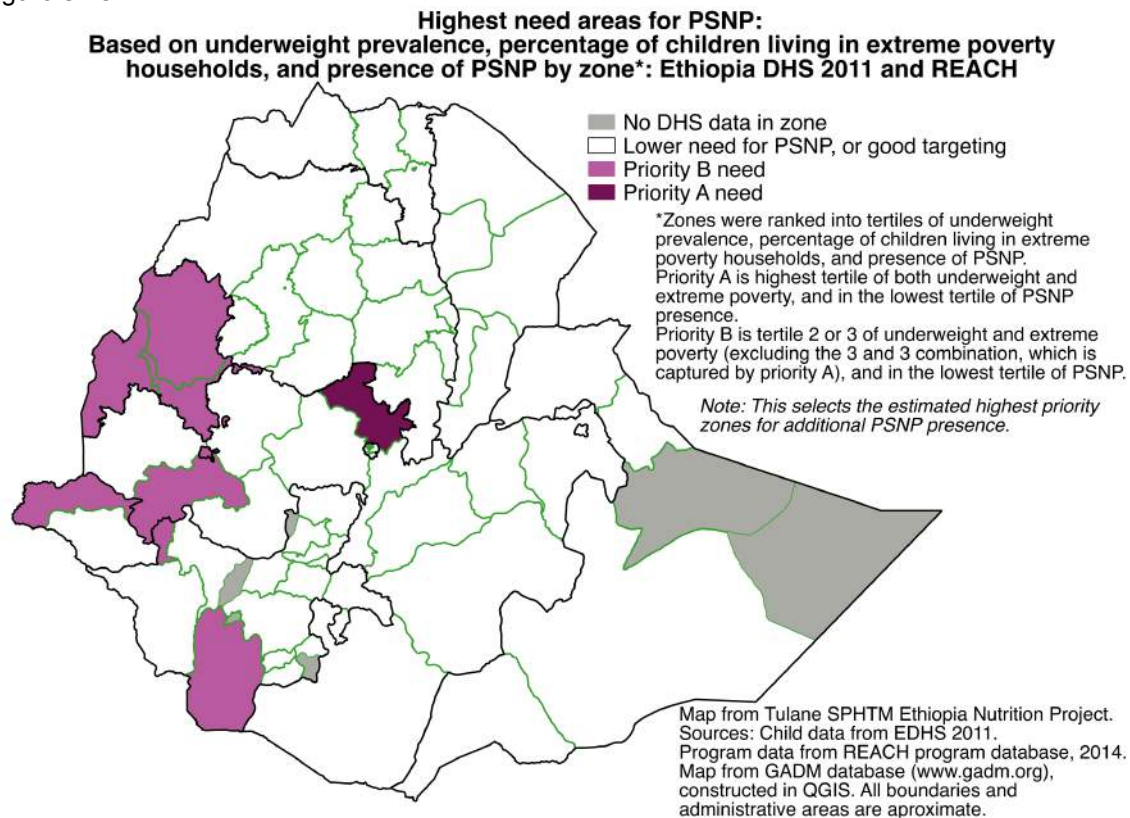


Figure 3.26.

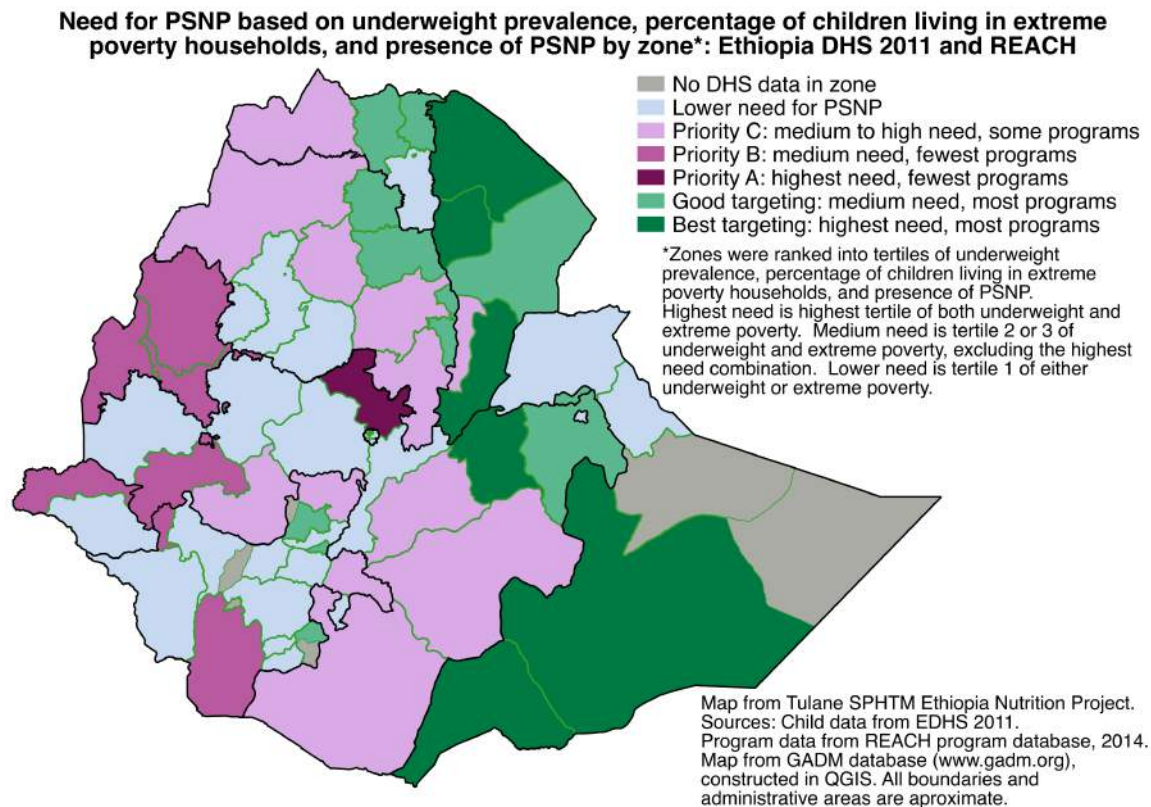


Table 3.9. Summary of need for, and presence of PSNP based on underweight prevalence, percentage of children in zone living in extreme poverty, and presence of PSNP.

In cells: priority or targeting type, number of zones.

		Need: based on prevalence of underweight & percentage of children living in extreme poverty		
		Highest Need ^a	Medium Need ^b	Low Need ^c
PSNP Presence	Fewest	Priority A 1 zones ^d	Priority B 7 zones ^e	17 zones
	Some	Priority C 12 zones		7 zones
	Most	Best Targeting 6 zones	Good Targeting 10 zones	6 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children living in extreme poverty.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children living in extreme poverty. This excludes the zones in tertile 3 of both prevalence and extreme poverty as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children living in extreme poverty. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (PSNP).

^d Priority A zones

Oromia: North Shewa

^e Priority B zones

Benishangul-Gumuz: Asosa, Kemashi, Metekel

Gambela: Zone 1

Oromia: Illu Babor

SNNP: Shaka, South Omo

Table 3.10. Number of zones by tertile of underweight prevalence, percentage of children living in extreme poverty, and presence of PSNP.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
Extreme poverty ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
PSNP Presence ^c	Fewest	1	2	0	4	1	2	3	3	9	25
	Some	3	3	1	2	4	2	0	2	2	19
	Most	6	4	2	3	3	2	0	1	1	22
Totals		10	9	3	9	8	6	3	6	12	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3% < prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone living in extreme poverty and split into tertiles: high is extreme poverty > 21.8%, mid. is 7.5% < extreme poverty < 21.8%, low is extreme poverty < 7.5%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with PSNP, then split into tertiles: fewest PSNP presence is 0% of children in the zone are in a woreda with PSNP (more than 1/3 of the zones had no PSNP presence), some is > 0% and < 90.8%, most is > 90.8%.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for PSNP

IYCF & CBN need

Anthropometry (repeated)

Figure 3.27.

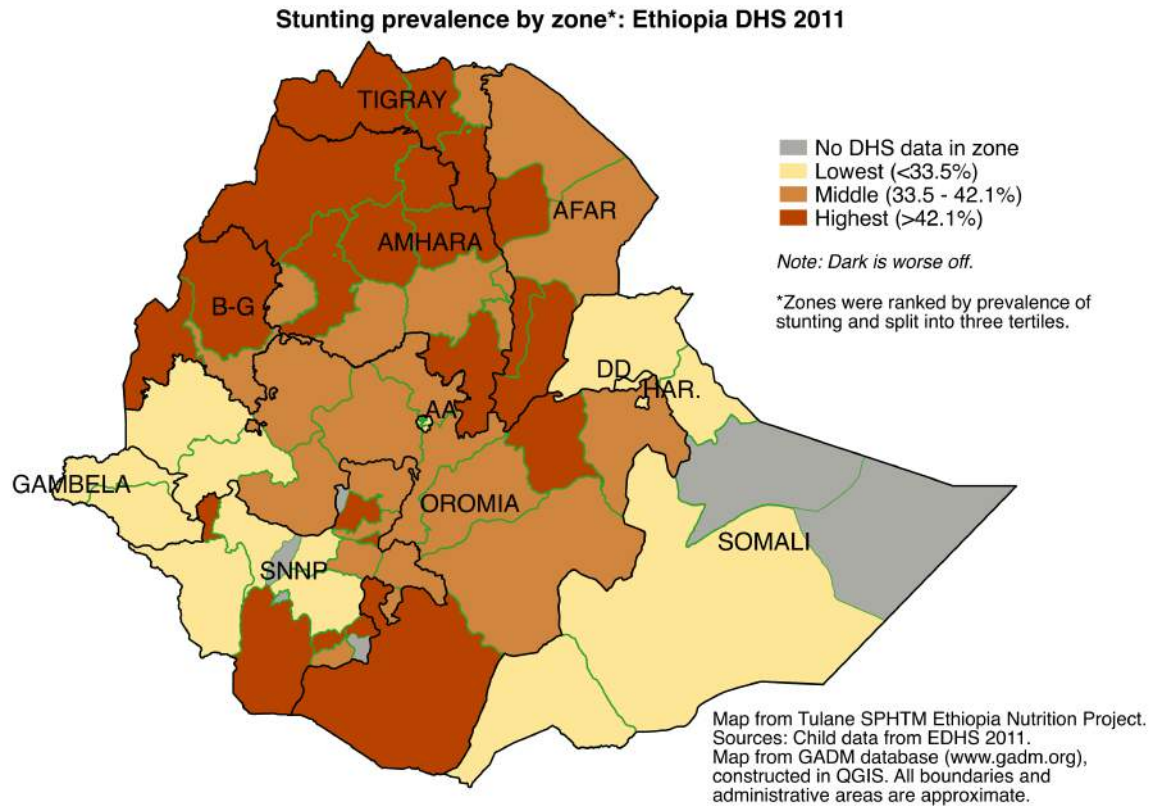


Figure 3.28.

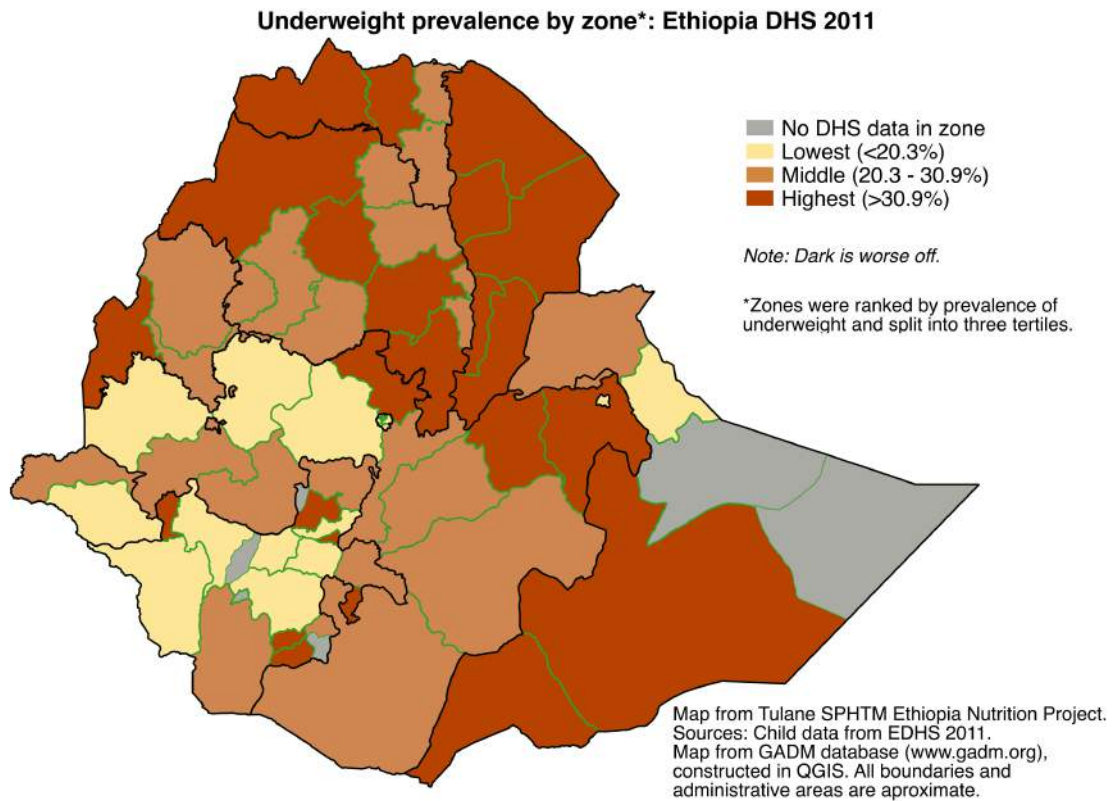
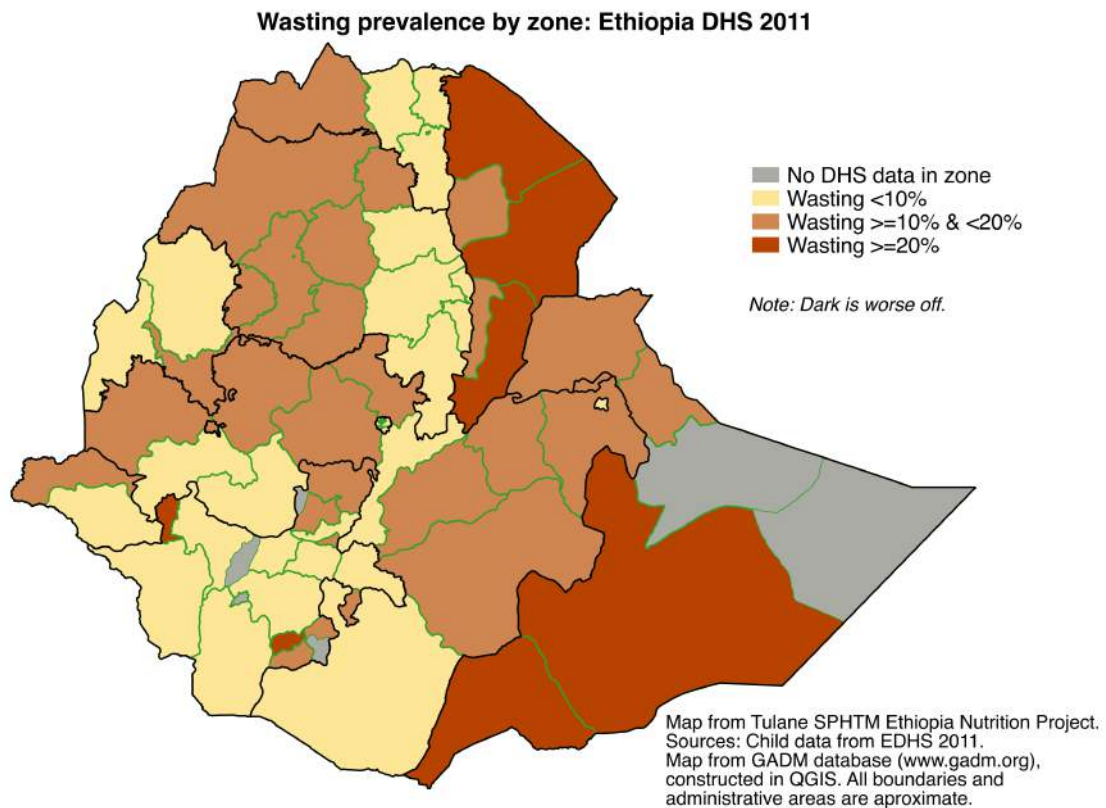


Figure 3.29.



IYCF program need

Figure 3.30.

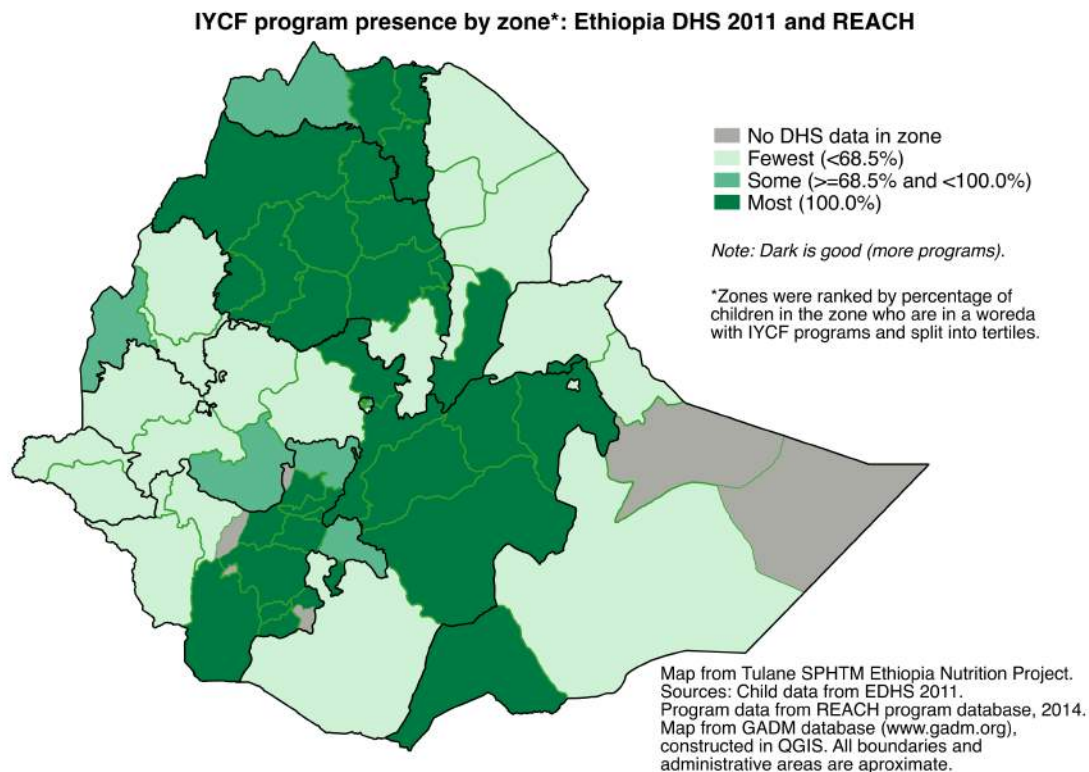


Figure 3.31.

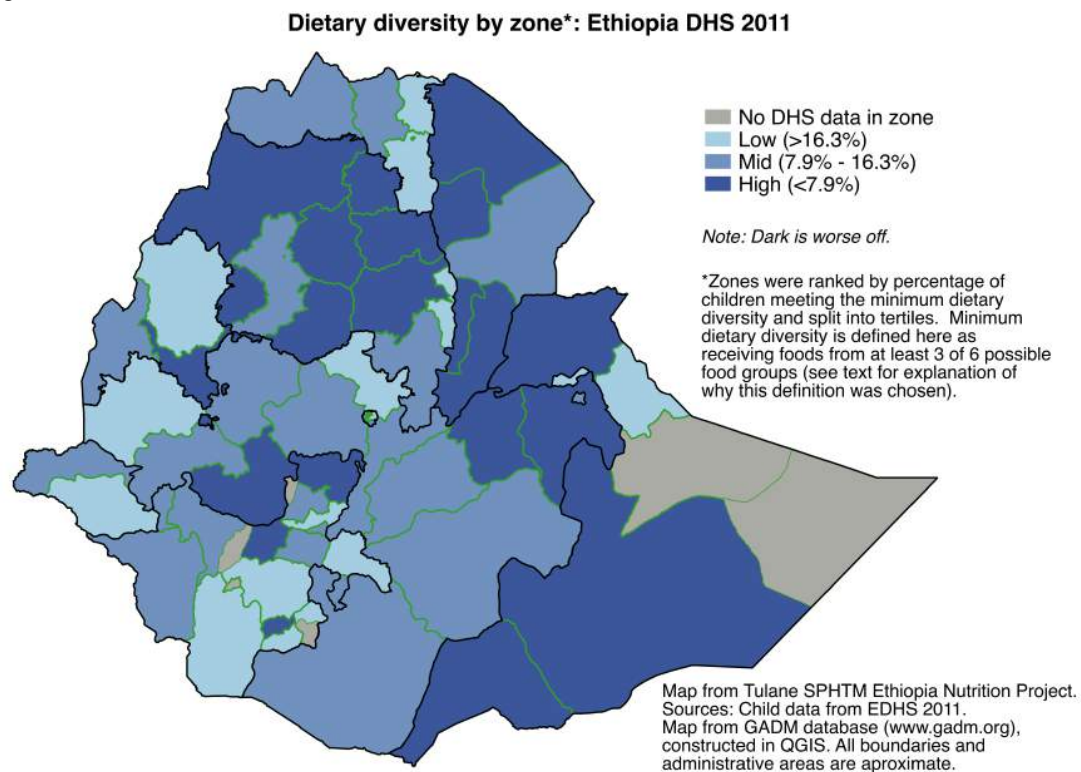


Figure 3.32.

**Highest need areas for IYCF programs:
Based on underweight prevalence, percentage of children with unmet minimum dietary
diversity, and presence of IYCF programs by zone*: Ethiopia DHS 2011 and REACH**

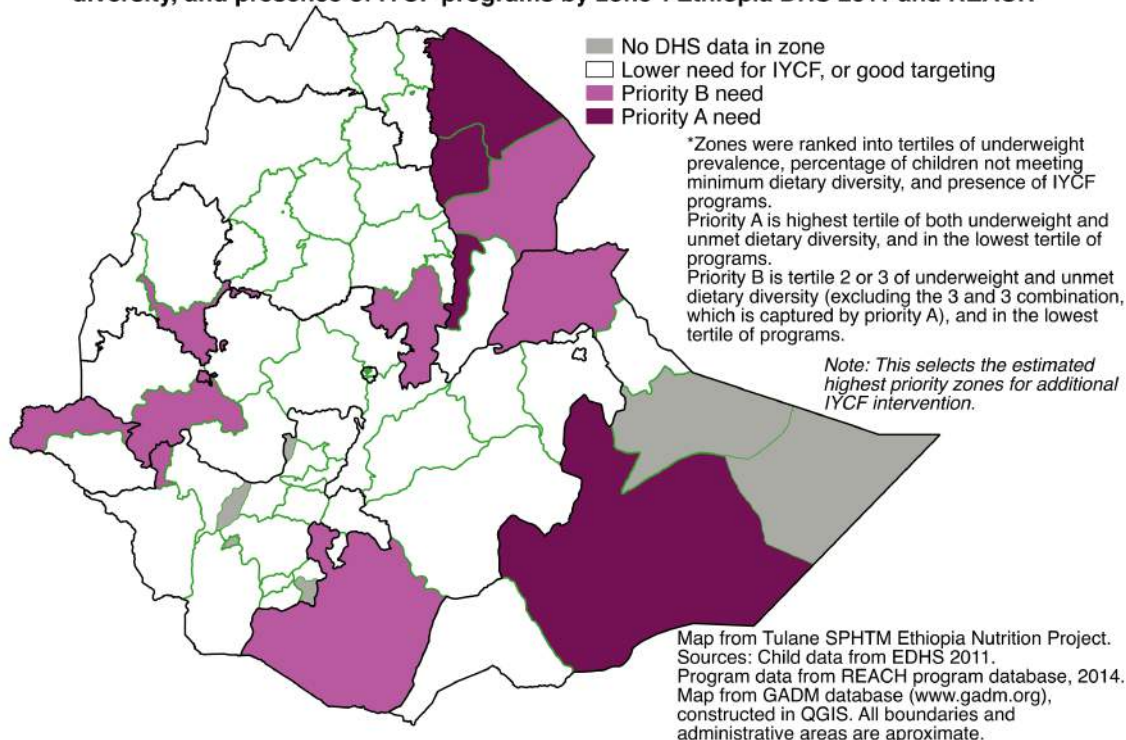


Figure 3.33.

**Need for IYCF programs based on underweight prevalence, percentage of children with
unmet minimum dietary diversity, and presence of IYCF programs by zone*: Ethiopia DHS
2011 and REACH**

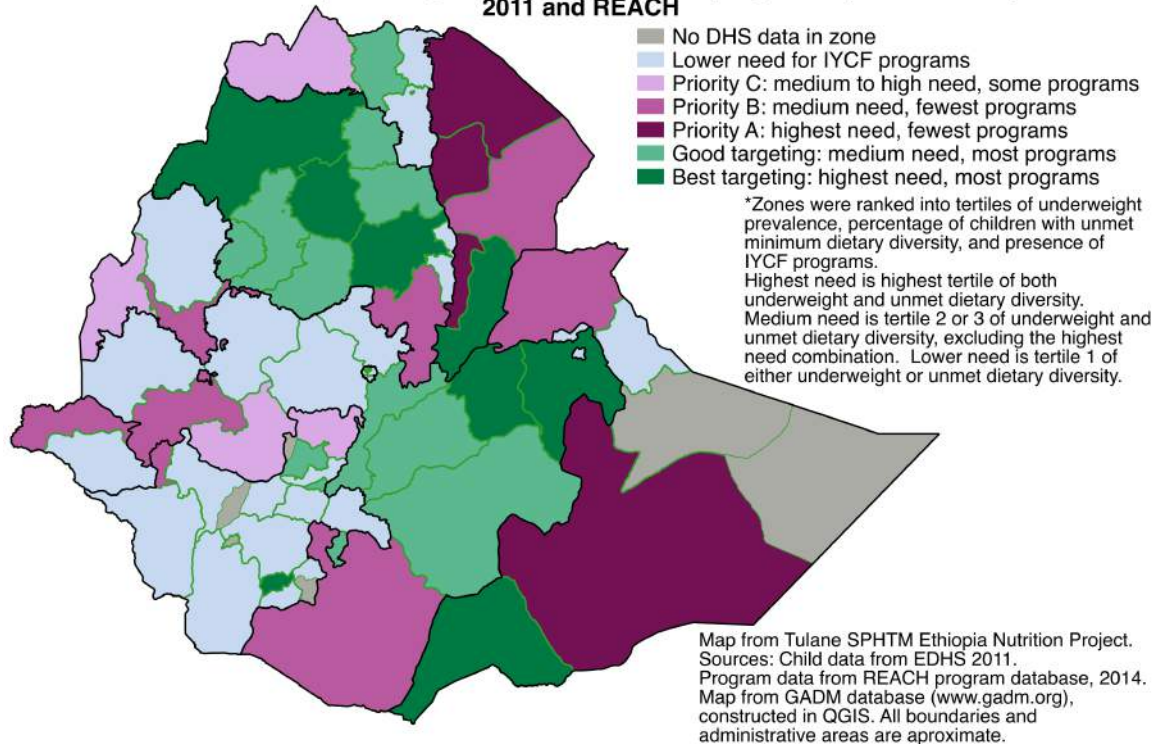


Table 3.11. Summary of need for, and presence of IYCF programs based on underweight prevalence, percentage of children in zone meeting the minimum dietary diversity (MDD), and presence of IYCF programs.

In cells: priority or targeting type, number of zones.

		Need: based on prevalence of underweight & percentage of children meeting the minimum dietary diversity requirement		
		Highest Need ^a	Medium Need ^b	Low Need ^c
IYCF Program Presence	Fewest	Priority A 4 zones ^d	Priority B 8 zones ^e	10 zones
	Some	Priority C 4 zones		4 zone
	Most	Best Targeting 8 zones	Good Targeting 11 zones	17 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children not meeting the minimum dietary diversity.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children not meeting the minimum dietary diversity. This excludes the zones in tertile 3 of both prevalence and not meeting the minimum dietary diversity as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children not meeting the minimum dietary diversity. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (IYCF programs).

^d Priority A zones

Afar: Zone 2, Zone 4, Zone 5
Somali: Afder

^e Priority B zones

Afar: Zone 1
Amhara: North Shewa
Benishangul-Gumuz: Kamashi

Gambela: Zone 1
Oromia: Borena, Ilu Babor
Somali: Shinile
SNNP: Shaka

Table 3.12. Number of zones by tertile of underweight prevalence, percentage of children not meeting the minimum dietary diversity, and presence of IYCF programs.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
MDD un-met ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
IYCF Programs ^c	Fewest	4	3	0	2	3	1	0	6	3	22
	Some	0	2	0	2	0	1	0	1	2	8
	Most	8	3	2	4	4	6	2	1	6	36
Totals		12	8	2	8	7	8	2	8	11	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3%< prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone not meeting the minimum dietary diversity and split into tertiles: high is MDD met < 7.9%, mid. is 7.9% < MDD met < 16.3%, low is MDD met > 16.3%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with an IYCF, then split into tertiles: fewest IYCF programs is <68.5%, some is 68.5%< IYCF programs< 100.0%, most is 100.0% of children are in woredas with IYCF programs.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for IYCF programs

CBN Program need

Figure 3.34.

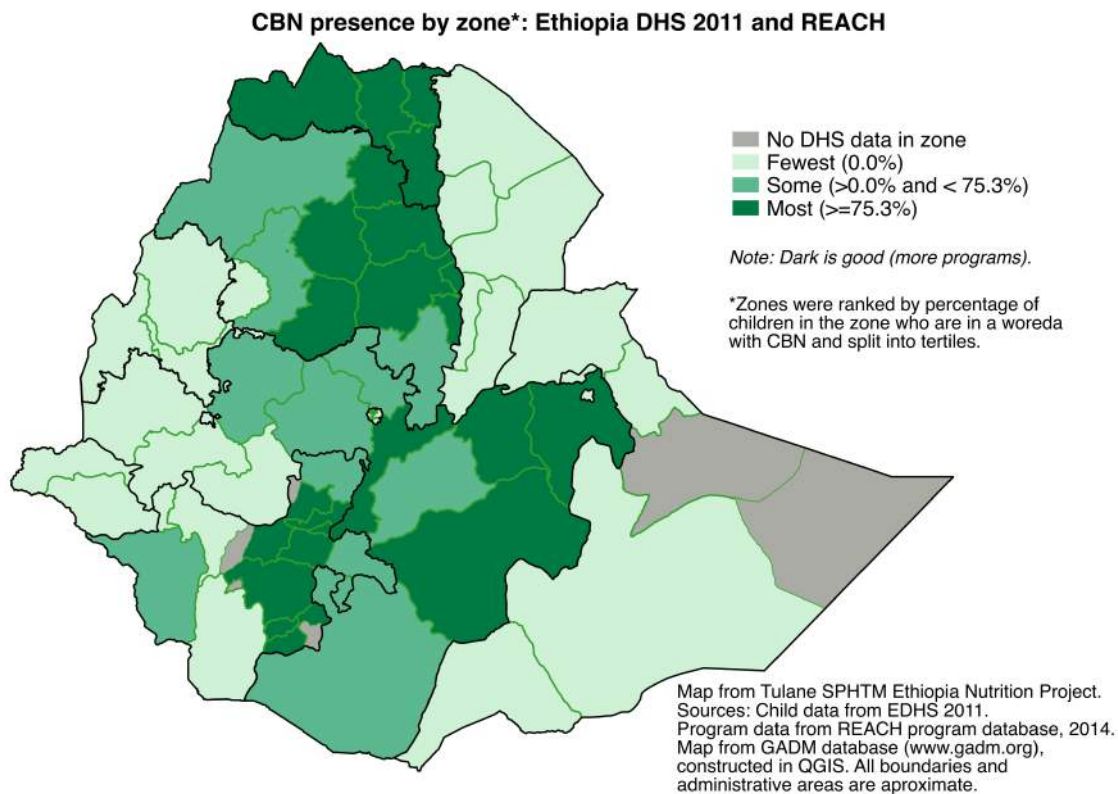


Figure 3.35.

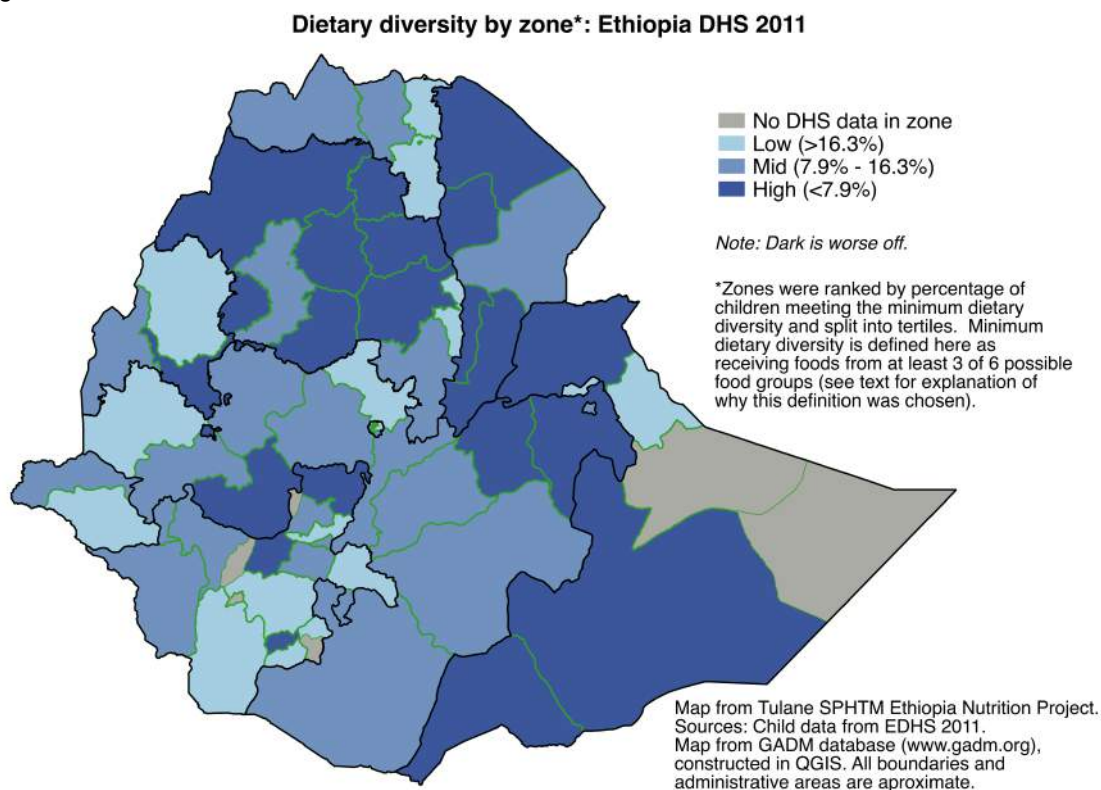


Figure 3.36.

Highest need areas for CBN:
Based on underweight prevalence, percentage of children with unmet minimum dietary diversity, and presence of CBN by zone*: Ethiopia DHS 2011 and REACH

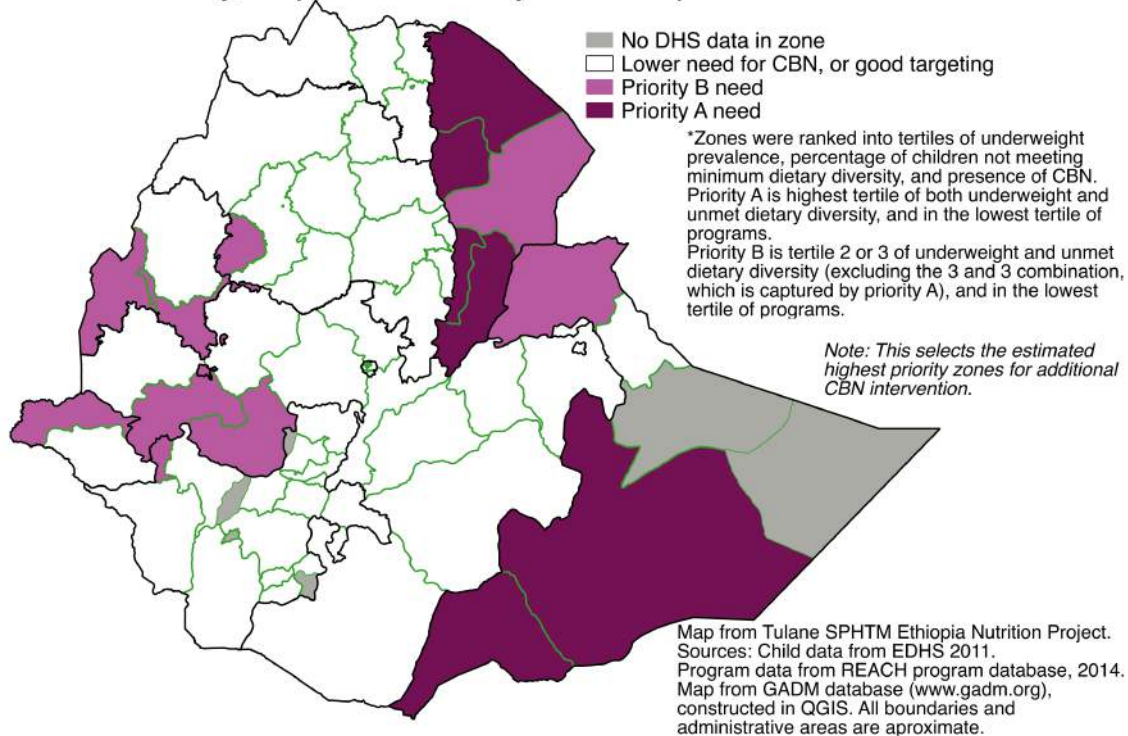


Figure 3.37.

Need for CBN based on underweight prevalence, percentage of children with unmet minimum dietary diversity, and presence of CBN by zone*: Ethiopia DHS 2011 and REACH

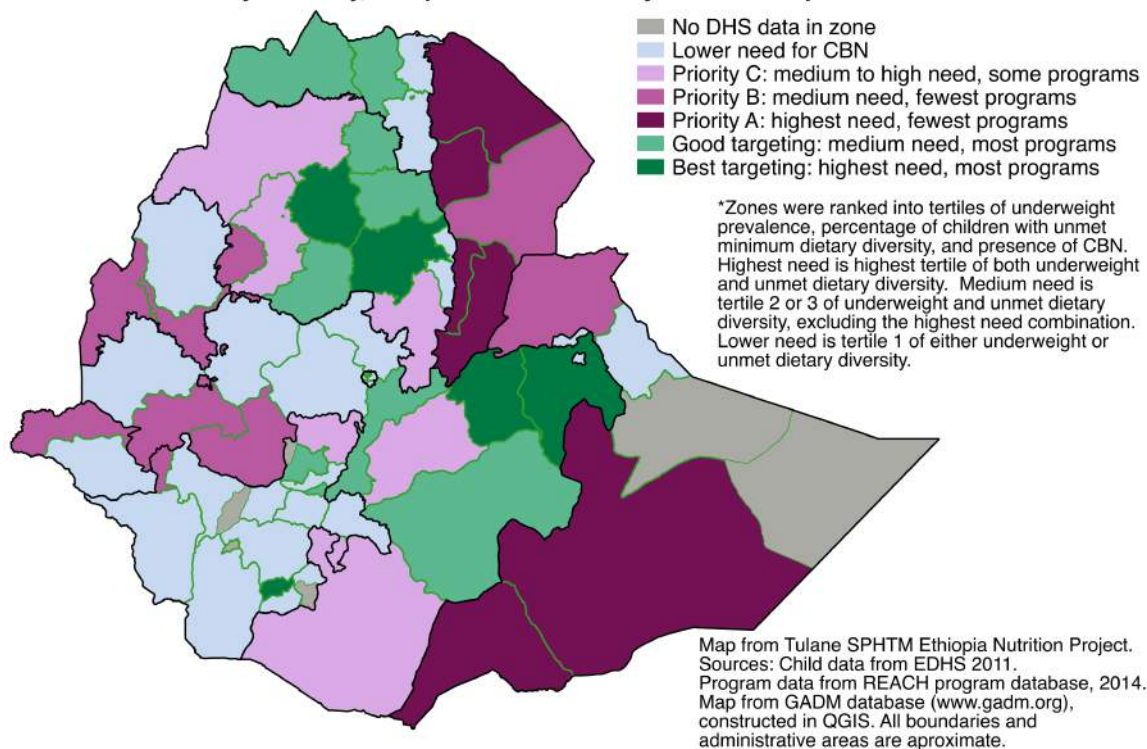


Table 3.13. Summary of need for, and presence of CBN based on underweight prevalence, percentage of children in zone meeting the minimum dietary diversity (MDD), and presence of CBN programs.

In cells: priority or targeting type, number of zones.

		Need: based on prevalence of underweight & percentage of children meeting the minimum dietary diversity requirement		
		Highest Need ^a	Medium Need ^b	Low Need ^c
CBN Program Presence	Fewest	Priority A 6 zones ^d	Priority B 9 zones ^e	17 zones
	Some	Priority C 7 zones		5 zone
	Most	Best Targeting 5 zones	Good Targeting 8 zones	9 zones

^a Highest need zones are in the highest tertile for both underweight prevalence and percentage of children not meeting the minimum dietary diversity.

^b Medium need zones are in tertile 2 or 3 for both underweight prevalence and percentage of children not meeting the minimum dietary diversity. This excludes the zones in tertile 3 of both prevalence and not meeting the minimum dietary diversity as they are captured in the highest need category.

^c Low need zones are in tertile 1 of either underweight prevalence or percentage of children not meeting the minimum dietary diversity. Note that some low need zones may be in the highest tertile for one of these, but they are not deemed in need of the program presented for here (CBN program).

^d Priority A zones

Afar: Zone 2, Zone 3, Zone 4, Zone 5
Somali: Afder, Liben

^e Priority B zone

Afar: Zone 1
Amhara: Awi
Benishangul-Gumuz: Asosa,
Kamashi

Gambela: Zone 1
Oromia: Ilu Babor, Jimma
Somali: Shinile
SNNP: Shaka

Table 3.14. Number of zones by tertile of underweight prevalence, percentage of children not meeting the minimum dietary diversity, and presence of CBN programs.

In cells: number of zones.

Prevalence of underweight ^a		Highest Underweight Prevalence			Mid. Underweight Prevalence			Lowest Underweight Prevalence			Totals
MDD un-met ^b		High	Mid.	Low	High	Mid.	Low	High	Mid.	Low	
CBN Programs ^c	Fewest	6	3	0	4	2	3	1	4	9	32
	Some	1	2	1	1	3	1	0	3	0	12
	Most	5	3	1	3	2	4	1	1	2	22
Totals		12	8	2	8	7	8	2	8	11	66

^a Zones were ranked by prevalence of underweight and split into tertiles: highest is prev. >30.9%, mid. is 30.3%< prev. < 30.9%, low is prev. <20.3%.

^b Zones were ranked by percentage of children in the zone not meeting the minimum dietary diversity and split into tertiles: high is MDD met < 7.9%, mid. is 7.9% < MDD met < 16.3%, low is MDD met > 16.3%.

^c Zones were ranked by the percentage of children in the zone who are in a woreda with CBN, then split into tertiles: fewest CBN programs is 0.0%, some is 0.0%< CBN programs< 75.3%, most is CBN programs >75.3%.

Color Key	
	Priority A: Highest need, fewest programs
	Priority B: Mid level need, fewest programs
	Priority C: Mid. to high level need, some programs
	Good targeting: Mid level need, most programs
	Best targeting: Highest need, most programs
	Lower need for IYCF programs

3.B Resources - Figures

Figure 3.38. Funds distributed by donor, DAC 2013.

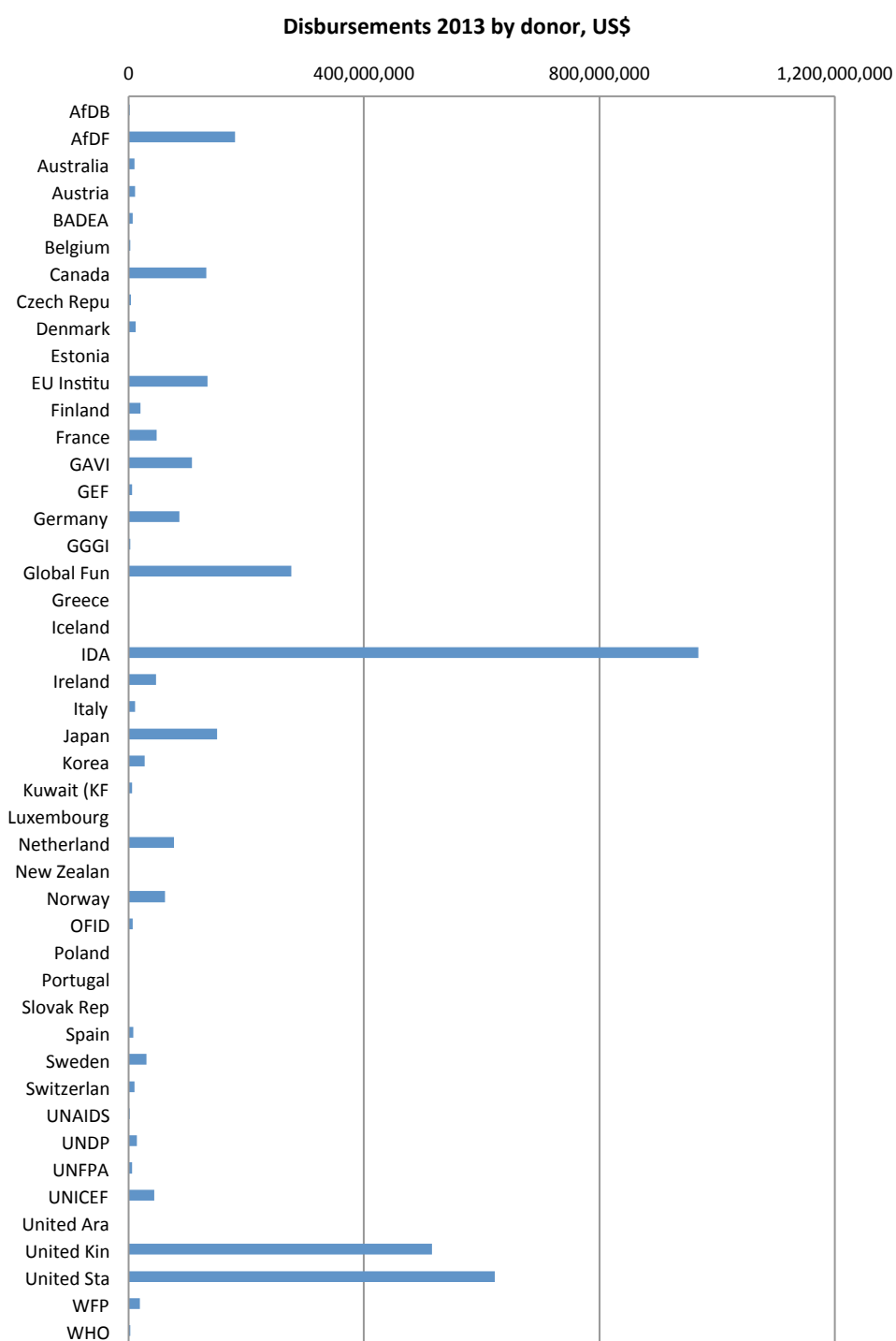


Figure 3.39. Funds distributed by sector, DAC 2013.

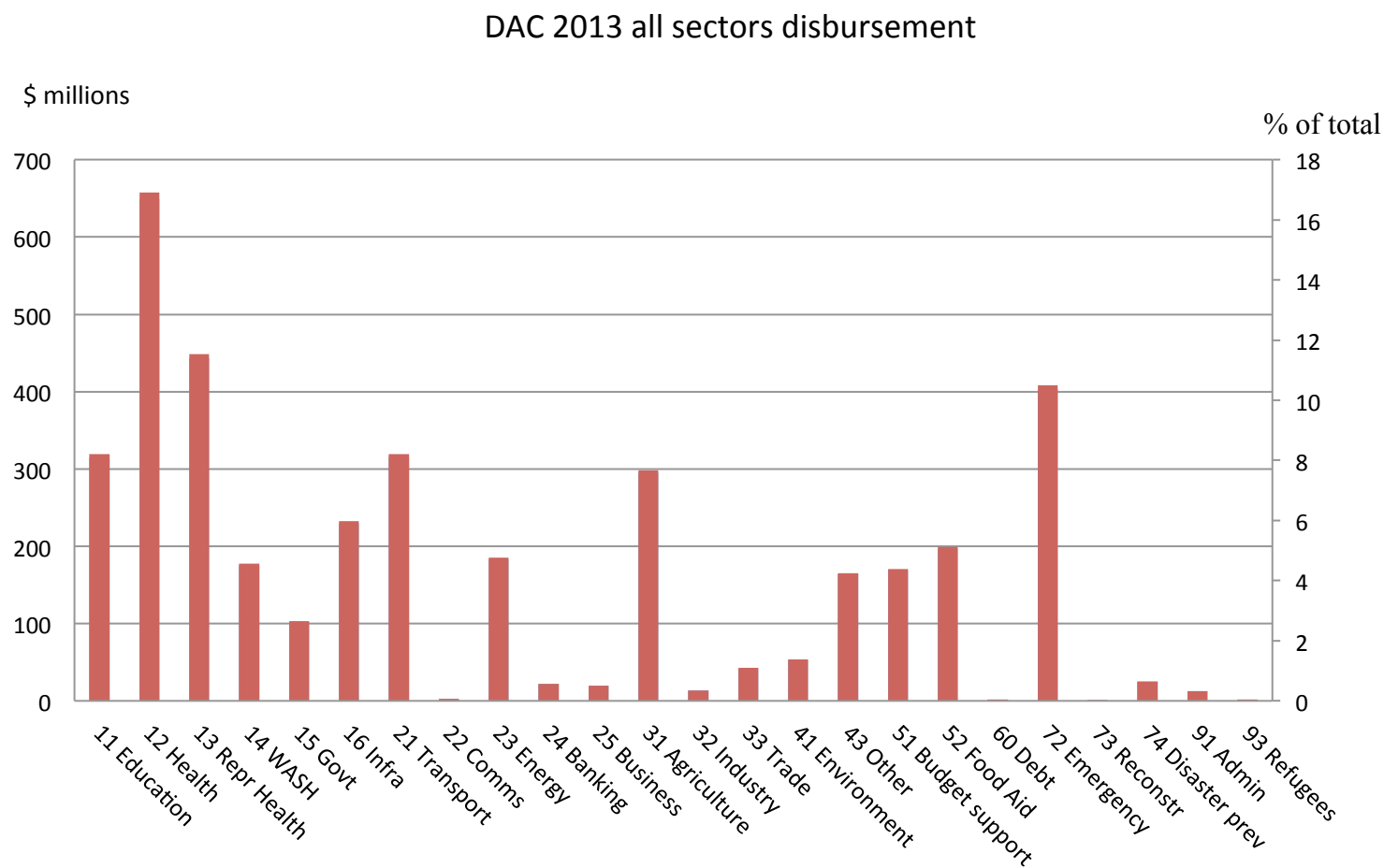
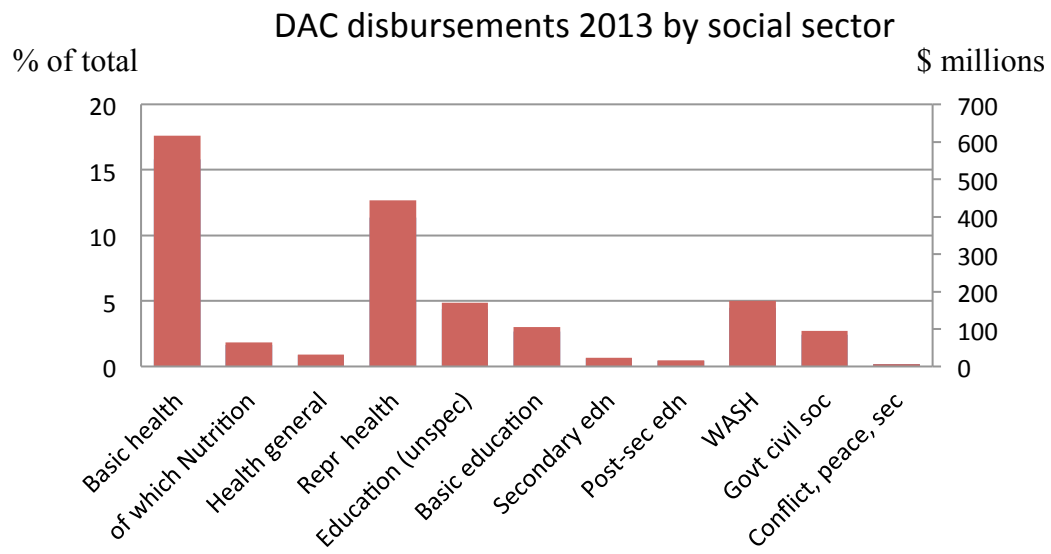


Figure 3.40. Funds distributed by social sector, DAC 2013.



3.B Resources – Tables

Table 3.15. Funds distributed by donor, DAC 2013.

Donor_Name	Sum (US\$ millions)	Mean by project (US\$ millions)	Number of projects
African DB	1,447,810	1,447,810	1
African Dev Fund	180,846,827	13,911,294	13
Australia	10,360,862	220,444	47
Austria	10,631,226	221,484	48
BADEA	7,200,000	900,000	8
Belgium	2,518,753	109,511	23
Canada	131,842,770	482,941	273
Czech Repu	3,586,802	91,969	39
Denmark	12,311,471	820,765	15
Estonia	9,294	9,294	1
EU Institu	134,052,377	647,596	207
Finland	20,640,766	308,071	67
France	47,967,143	737,956	65
GAVI	108,045,961	7,717,569	14
GEF	6,079,507	675,501	9
Germany	85,994,546	614,247	140
GGGI	2,380,680	2,380,680	1
Global Fun	276,053,297	46,008,883	6
Greece	94,727	18,945	5
Iceland	194,836	194,836	1
IDA	967,610,810	8,959,359	108
Ireland	46,587,010	412,274	113
Italy	11,041,342	147,218	75
Japan	150,116,272	682,347	220
Korea	27,338,519	119,906	228
Kuwait (KF	5,711,923	5,711,923	1
Luxembourg	776,747	59,750	13
Netherland	76,650,727	1,869,530	41
New Zealan	43,927	43,927	1
Norway	62,291,396	490,483	127
OFID	6,789,281	1,357,856	5
Poland	269,137	24,467	11
Portugal	35,153	17,576	2
Slovak Rep	17,470	8,735	2
Spain	8,223,842	171,330	48
Sweden	30,201,486	284,920	106
Switzerlan	10,010,546	455,025	22

UNAIDS	1,751,628	350,326	5
UNDP	13,857,360	769,853	18
UNFPA	5,716,928	85,327	67
UNICEF	43,873,468	421,860	104
United Ara	43,796	14,599	3
United Kin	515,772,580	3,349,173	154
United Sta	622,236,120	1,095,486	568
WFP	18,907,929	2,100,881	9
WHO	3,375,506	108,887	31
Total	3,671,510,557	1,197,883	3065

Table 3.16. Summary of WASH educational projects, DAC 2013.

	Project Title	Donor Name	Amt
1	Facilitate the access to water resources of Somali, through the improvement of the technical capacities of Water Bu	Spain	527,744
2	Guided Learning on Water Supply and Sanitation Project in Southern Nation, Nationalities and Peoples Regions	United Kin	141,892
3	East Africa School Water, Sanitation and Hygiene (WASH) Program	Canada	110,910
4	Water, Sanitation and Hygiene (WASH) for Maternal, Newborn and Child Health	Canada	83,482
5	NLM-SWS Community Based Health Service Project, Water	Norway	5,999
Total	N	5	5
	\$		\$759,000

a. Limited to first 100 cases.

Table 3.17. Categorization of projects by sector according to relevance to nutrition from random sample of all projects by sector, DAC 2012.

Nutrition category					
<i>Projects sampled in:</i>	Number assessed	Specific	Sensitive A	Sensitive B	Other
Health ¹	40	5	19	13	4
	%	13	48	33	10
Agriculture ²	243	19	67	113	35
	%	8	28	47	14
WASH	43	2	7	28	2
	%	4	12	68	5
Reprod. Hlth	22	15	2	4	3
%		0	12	77	14
<i>All projects</i>					
Nutrition	25	17	6	1	1
	%	68	24	4	4

¹ This is a random sample (of 192 health projects), and excludes the 25 nutrition projects in the last rows.

² All 243 projects assessed in agriculture sector

Table 3.18. Total number of projects and funds allocated in relevant sectors, DAC 2012-2013.

	ALL PROJECTS			
Sector	2012 (number of projects)	2012 amount (million USD)	2013 (number of projects)	2013 amount (million USD)
Basic Health & Health, general (a)	220	\$214.1	302	\$649
Agriculture & Forestry	321	\$138.6	335	\$270.2
Water Supply & Sanitation	124	\$65.6	156	\$175.1
Population Pol./Progr. & Reproductive Health	573	\$321.8	319	\$443.2
Basic Nutrition	25	\$31.8	38	\$64.1
Total	1210	\$738.1	1112	\$1,537.5

(a) Nutrition is included as a sub-sector of the Health Sector

Source: DAC data; <http://www.oecd.org/development/stats/idsonline.htm>

Table 3.19. Number of projects and funds allocated from projects greater than 1 million USD in relevant sectors, DAC 2012-2013.

PROJECTS > \$1 MILLION				
Sector	2012		2013	
	Number of projects	Funds (\$millions)	Number of projects	Funds (\$millions)
Basic Health and Health, General	22	\$190	55	\$608
Agriculture and Forestry	32	\$95	55	\$223
Water Supply and Sanitation	18	\$53	25	\$153
Population and Reproductive Health	59	\$287	57	\$397
Basic Nutrition	5	\$28	10	\$57
Total	80	\$624	192	\$1,381

Table 3.20. Categorization of projects that are greater than 1 million USD in relation to relevance to nutrition, DAC 2013.

Nutrition Category						
2013 Projects > \$1m	Number assessed	Specific	Sensitive A	Sensitive B	Not relevant	Other
Health	55	8	5	38	1	3
	%	15	9	69	2	5
Agriculture	55	1	6	47	0	2
	%	2	11	85	0	4
WASH	25	1	3	17	0	4
	%	4	12	68	0	0
Reprod. Hlth	57	0	7	44	0	6
	%	0	12	77	0	4
All projects						
Nutrition	38	32	1	3	1	1
	%	84	3	8	3	3

Table 3.21. Sample descriptions of agricultural projects from DAC database.

Sample Descriptions	
1018	The Program's Development and Global Environment Objectives are to reduce land degradation in selected sites within the broader landscapes in Ethiopia. The objective would be achieved through the provision of capital investments, technical assistance and capacity building for small holder farmers and government institutions at national and sub-national levels. (<i>scored nutrition-sensitive A</i>)
2723	GFSI: The project will work closely with the dairy farm cooperatives and dairy processor and producers to address dairy constraints along the value chain. The new project will focus on milk-shed development, artificial insemination services, stimulating business development and market linkages, and provide technical assistance. The project will also provide training on management, marketing and dairy technology.
2724	GFSI: Pastoralist Resiliency Improvement and Market Expansion (PRIME) is a five year \$32 million project that will begin around January 2012 and end December 2016.
2728	GFSI: Agri-business and Market Development Project (AMDe). The AMDe project aims to enhance access to finance, stimulate innovation and private sector investment, and increase the competitiveness of select value chains in these AGP targeted woredas. Focus commodity value chains under AMDe include maize, wheat, coffee, sesame, honey, and chickpea, which were prioritized by the GoE and AGP donors mainly for their market potential.
878	Financial contribution shall halt degradation of agricultural land and natural resources by managing water disposal, land management and project management.
512	(Agro-) Pastoralists manage their resources sustainably.
644	Norway has recently approved enrollment in the GGGI justified by the Norwegian climate strategic objectives to promote green growth in developing countries. In Ethiopia, the support is focused on implementation of the Climate Resilient Green Economy Strategy that the Government of Ethiopia launched in November/December 2011.
1726	The project aims to increase economic, social and ecological resilience to climate variability and change of 12,000 resource-poor farming households in the Woreda district of Fogera in the Amhara Regional State of Ethiopia. Food and nutrition security of beneficiaries is increased by promoting diversified and integrated crop and livestock production systems, increasing soil fertility and making better use of available water. The sustainable management of natural resources in the wider catchment area is improved by restoring private and community-owned forests and grasslands through effective, affordable and replicable solutions. The project also strengthens local stakeholders capacity to negotiate and jointly implement actions to restore and enhance selected natural capital assets through a collaborative landscape approach
725	To invest in activities which will build climate resilience and promote low carbon growth in Ethiopia. This will help 1.5 million people to cope with the effects of climate change by 2015, help Ethiopia to protect livelihoods, services, infrastructure, and...

3.C Results of qualitative components of situation analysis work – Tables

Table 3.23. Summary of findings from project and woreda case studies.

Project	Coverage (national) ¹	Coverage (local)	Participation (local)	Resource Intensity	Targeting (local)	Programme content – nutrition relevance
One WASH National Program (OWNP)	Improved water access: 52% Improved sanitation access: 24% ³⁸	Medium-Low	Medium-Low		All households for water and sanitation provision, not specific to nutrition	Unimproved water supply and sanitation access are associated with poorer child nutritional status
One WASH Plus (OWP)		Low (pilot programme in eight towns currently)	Not available	US \$28/person	Not observed	
Water, Sanitation and Hygiene, Multiple Use Services and Community Based Nutrition (WASH/MUS/CBN)	4-8% (30-55/675 woredas in 4 regions)	Low (pilot programme in 30 woredas currently; WASH/CBN in 55 woredas)	Not available	US \$16/person	All households in selected woredas for water and sanitation provision	
Alive and Thrive	22-24%	High	High	US\$2.22/person	All households with	Optimal for

³⁸ WHO/UNICEF, 2014. Joint Monitoring Programme for Water Supply and Sanitation. Estimates on the use of water sources and sanitation facilities; updated April 2014. Ethiopia.

(A&T)*	(150-160/675 woredas in four targeted regions)				pregnant/lactating women or under-2 children. Programme activities targeted to kebele needs.	meeting nutrition objectives through multipronged approach including SBCC, mass media, capacity building.
Community Based Nutrition (CBN) / Growth monitoring and promotion (GMP)	Expanded by approx 100 woredas/yr since 2008.	High	Variable, 30-50%	~US\$7 under 2 child per year ³⁹	All under-2 children	See text. CBN is the main direct nutrition program.
Agricultural Growth Programme (AGP)**	17% (96/566 rural woredas in four targeted regions) 23% hhds	Medium	Medium	US\$127.8/hh US\$26.1/person	All households, not specific to nutrition vulnerability (e.g. under-2, PLW)	Limited relevance will be improved if activities are nutrition sensitive and targeted to vulnerable groups (PLW, under-2 children).
Empowering New Generations in Improved Nutrition and Economic opportunities (ENGINE)	25% of rural woredas in four targeted regions (100/402 rural woredas by	Medium (nutrition specific and WASH interventions) Low (nutrition sensitive	Through HEP, data NA Low for nutrition sensitive	US\$7.5/person	Nutrition specific: PLW and under-5 children Nutrition sensitive: vulnerable households with	Programme content is relevant for improving nutrition. Nutrition sensitive interventions:

³⁹ Community-based activities under CBN/GMP only (i.e. initial training and integrated refresher training of HEWs, cascade training of HDA, GMP equipment and supplies, review meetings, and implementation support)

2015)	interventions, targeted approach)	(targeted approach)	PLW or under-2 children	major project focus, low coverage, intensive resource needs; sustainability highly questionable.

Productive Safety Net Programme (PSNP)	37% (312/849 woredas (national, 2015)	High	High	Donor resources \$36m in 2013.	Households meeting criteria for chronic food insecurity, not specific to nutrition.	Direct support with conditions for PLW and caretakers of children with SAM

¹Calculated based on target population of project. Number of woredas taken from NNP monitoring tool: 675 urban and rural woredas in four big regions: Amhara, Oromia, SNNPR and Tigray, 566 rural woredas.

*Information based on Phase 1 of project, at time of field study implementation was not ongoing.

**Specific to nutrition sensitive aspects of the AGP.

Table 3.24. Summary of estimates of funds used by sector/programme, totals needed if scaled to national level, and donor funds in 2013.

Sector/programme	Estimated cost/person used	Total if scaled to national level	Donor disbursement 2013
WASH	\$16-28/person	\$1.5 billion	\$175 million
Community nutrition	\$2-10/child/year	\$180 million/year	\$64 million
Agriculture	\$26/person (/year?)	\$2.3 billion	\$270 million
PSNP	TBD	TBD	\$36 million

Note: summarized from data in this section and in section 3c on resources, from DAC data.

4. Gaps and Opportunities – Direct nutrition interventions

Summary

Two broad types of opportunity present themselves: extending, reinforcing, and targeting the large programmes that directly impact food consumption and nutrition (WASH, CBN, PSNP, HEP); and taking advantage of, or mitigating, the effect modifiers (interactions) that are commonly found likely to affect these programmes' impact on child nutrition. Whole new programmes are not suggested by the data, as is to be expected when there has been vigorous and broad government and donor action to address the range of poverty-related issues in Ethiopia.

Gaps to be filled are represented in the maps in the previous section. These indicate that large areas of the country, with high prevalences of risk factors and malnutrition, are in need of programmes. While there is some good targeting, most bears little relation to need. This could be a priority for review and for decisions on use of additional resources (not primarily shifting resources – the better-served areas probably still need their programmes). This applies not only to nutrition (CBN), but to WASH, PSNP, and even HEP.

Second, many interventions – most of those examined in fact – have more impact on the less-poor than the poorest. In some cases, for example water supply, this suggests that additional steps are needed, as water supply is improved, to change behaviours so that there is more benefit to child health and nutrition. In others, the programme design itself may need to find ways to better involve the poorest. In the case of improving IYCF, this relation is usefully equity-positive, and of itself is expected to benefit the poorest.

Context: interpretation of evidence on trends and correlates of child malnutrition

The results reported in the previous sections aimed at identifying gaps in programmes' coverage and content with respect to child malnutrition. This is now to be applied to consideration of new and/or adjusted programmes, for UNICEF and GoE planning for the next round of country programming, in terms of:

1. Gaps in coverage (and participation): filling these is one set of options.
2. Interactions of potential causal factors – where one modifies the effect of another – suggesting beneficial adjustments to programmes to increase nutritional impact.
3. New factors that appear to have not yet been taken into account, or not fully.

The context for this needs to be understood and provide a reasonably widely acceptable interpretation of the nutrition situation, and importantly its evolution. This section aims to do this based on our analyses and associated data.

The rapid economic growth in recent years, notably since 2004, estimated as around 11% per year in GNIⁿⁿ, GNI¹ would be expected to have a major effect on household income, expenditures, and consumption. Results given in section 2b support and elaborate on this. However, the correlational analysis indicates that improvements in a number of aspects of SES (potential risk factors) also are associated with better child nutrition. It should be recalled that most associations of child nutrition with risk factors are derived from cross-sectional analysis, and it is an assumption (but no more) that changing these factors will result in changes in nutrition through time. Combining trends and associations raises both conceptual and empirical issues.

First, it is striking that when defining poverty in absolute ('no-assets') or relative terms (wealth quintiles), roughly parallel improvement was seen in *all* groups. Children in households with 'no-assets' – no improved water, sanitation, or housing – in both 2000 and 2011 showed much the same changes through time as did those from households with improved assets, see figure 2.22. Second, viewing the associations of stunting prevalence with wealth quintile – see figure 2.19 – shows two surprisingly clear patterns. The association of stunting with wealth quintile in any year is essentially flat until the richest quintile: thus at any one time there is no association of relative wealth (based on measures of SES) with stunting for the poorest 80% of the population. Further, the pattern moves down much in parallel through time; probably only by 2014 were the children in less poor households are better grown than those in the poorest. To be clear, this latter result does not mean there is no effect of wealth – the poorest quintile in say 2011 is still likely to less poor than it was in 2005 – so we cannot interpret this from quintiles (one of their drawbacks). But we can see from the absolute poverty measure that in fact considerable improvement is observed *without any change* in these assets. Something else is happening, and that is likely to be income and food consumption.

In passing it is worth noting that suggestions that single factors – sanitation was recently invoked – as accounting for most or all of changes in child growth (apart from their violation of commonsense) fail to explain why a lot of improvement in child nutrition takes place *without* change in sanitation conditions. (Perhaps community effects might explain this in theory; but they do not here, see section on 'community effects', section 2b.)

The rapid rate of improvement in economic terms (see section 2b, 'Estimates of trends in income, expenditure and food consumption, 2000-14') was associated with a national level increase in kcal consumption estimated as from 2200 to 2450 kcals/person/day, see figure 2.33. The impact of this could be greater than the already substantial 14%, because the marginal effect could be assessed as, roughly (minimal requirement for basic metabolism plus moderate activity), i.e. approximately 1800 kcals; so 2200 is 400 kcals above this minimum, and 2450 is 650, an increase of 60%, which would support greater activity, both productive and discretionary, and may better estimate the effect of this increase.

Here, there is a steep slope by expenditure quintile with kcal consumption, meaning that as households get relatively richer they spend substantially more on food – see figure 2.35, and thus consume more kcals. This has not started to flatten (figure A), suggesting a demand for

ⁿⁿ <http://data.worldbank.org/country/ethiopia>

additional kcals that is not yet met. Reducing the overall % expenditure on food (figure B) allows more expenditure on other necessities, which also may well benefit child growth.

This increase is seen across all regions, and in general the estimated disparities remain – the higher consuming regions tend to stay higher, the lower remain lower – see for example SNNP and Oromia in figure 2.33. At this level of aggregation we don't expect to see much association of child nutritional status with kcal consumption, and this is so with these data – see figure 2.34 – which indicates a minor tendency for higher average kcal regions to have less stunting, and vice versa.

Income and total expenditure estimates through time (figure 2.37) show, first, the large extent of this development, and second that it was non-linear with time. Figure A suggests that most of the expenditure change came in the period 2005-11, and figure B, further, that income increases started in 2003, and then increased regularly at a high rate, such that the income estimates almost tripled, from 500 to 1400, in \$ equivalent purchasing power parity. Over this period relative food prices did rise somewhat, peaking in 2008, see figure 2.36, then stabilizing. This is consistent with food expenditure and hence consumption rising substantially, as well as non-food expenditures.

The conclusion overall is that increased income and household food availability probably accounts for much of the improved child nutrition in recent years, and this was spread throughout the country.

* * *

At the same time, this increase in consumption may swamp our estimates of the impact of correlates of malnutrition. DHS data does not include any estimates of consumption, only of assets. Moreover, there is the often-overlooked difficulty of connecting one-time cross-sectional findings with those estimated through time. Within this, it can be overlooked that a strong association cross-sectionally may only apply to a small group: a highly significant association of improved water supply may be produced because the richest 5% have water piped into the residence, but this may not be very helpful programmatically if we can only conclude that everyone needs piped water.

The consistency of large changes through time with relatively smaller changes associated with a risk factor, cross-sectionally, can be resolved as shown in figure 2.27, and accompanying text in section 2b ('how do observed trends by vulnerable group relate to cross-sectional correlations?'). In the example, a reduction in stunting for those with no-assets, and those with some assets, amounts to 15 percentage points (ppts) 2000-11 in either group (although the actual prevalences themselves for each group were different). However, some (estimated 34%) of the no-assets group in 2000 gained assets by 2011, and benefitted from an additional 5 ppts reduction as a result, estimated from the correlational analysis.

In other words, within the overall 15 ppts reduction in stunting, a large part should be attributed to economic development. This is supported by seeing that the improvements are similar for population groups in no-assets poverty and those with some assets; similar results are found for

education and other factors. However, when these changes are pulled apart, and the groups experiencing improvement in risk factors considered, the improvement in these is consistent with contributing to the overall change.

Fortunately we do have data on a range of risk factors that are relevant to programmes that in turn can benefit child nutrition. To recap, these are: water supply – sanitation – WASH; IYCF practices (at appropriate ages) – CBN; poverty – PSNP (and other programmes, however on which we do not have data); and health risk factors – health services.

Gaps in coverage and participation. Geographical targeting of projects is a major decision made in planning and management, and we can assess this in terms of orientation to need. Participation refers to how many households (or mothers and children) actually participate in the programme when it is operational in their area. As an example, in the mid-term review of CBN in 2012, we noted that CBN coverage in targeted woredas was high, but the participation rate was around 30%.^{2,3} Therefore it might have been a good policy, rather than continually expanding the coverage, to find out why participation rates were low and move to increase them. However here we do not have data on participation rates from the REACH data, and are restricted to coverage (moreover from 2013 data).

Deciding on changing programme coverage, adjusting the amount of resources used, and possibly how they are used, provides clear opportunities for increased impact on child nutrition. This is discussed with specifics below.

Adjusting programme content to allow for interactions. A number of interactions with potential to affect the impact of programme activities have been identified in the analysis (see section 2c). To reiterate, in this sense interactions mean ‘effect modification’: a clear example is that improved water supply is associated with better child growth only in those households where the mother has some education, and not where she doesn’t (see figure 2.44). This implies that an education component needs to be included or linked to water supply improvement for uneducated households, so these too see benefit in child growth.

Unfortunately most interactions are in this direction – the better-off, or better-educated, benefit more; we have called these ‘equity-negative’, implying that the intervention without taking care of the interaction will increase inequity. Those in the other direction in which the worse-off may benefit more (‘equity-positive’) provide a particular opportunity for directing resources to the worse-off. Improving IYCF practices is an example of ‘equity-positive’ interventions (for example, see figure 2.60).

These opportunities, as indicated by the analyses, will be detailed below.

Need for new interventions. No new risk factors of themselves (as opposed to interactive ones) were turned up by our analysis of the available data, and this is no real surprise. Risk factors for child malnutrition have been studied for decades and surely all those covered by DHS are known

in general. Newly important risk factors for Ethiopia were not stringently searched for, as we were focusing on programmatic needs, and most programmes have been tried or established, and expanded where promising.

However, comment on distribution of resources and priorities in the context of likely or actual programmes is feasible. Moreover, where programmes are expanding, experience from elsewhere can also be valuable: as examples, the evolution of PSNP towards a conditional cash transfer programme is following much positive experience particularly in Latin America,⁴ and this can be drawn on; for direct nutrition interventions, we know the parameters of those having an impact, and these can provide some guidance. This is given in sections below.

Principles. We can start identifying gaps and opportunities using the sets of maps, organized by the four types of programmes of interest. These are from section 3a. To recap, the maps display data by zone. They start by showing distribution of malnutrition, as prevalences of stunting and wasting; underweight can be seen as summarizing these two, and is the more general indicator. So that the maps can be self-standing by risk factor/programme, the nutrition maps are repeated for each of these. The next indicator mapped shows the reported programme coverage by zone (e.g. WASH programmes), followed by the prevalence of the risk factor concerned (e.g. poor drinking water). These are then combined to examine how programmes meet needs, in terms of both high risk, and child malnutrition.

Second, we can use the correlational analysis results to suggest aspects of programmes needed, both in terms of interventions, and possible effect modifiers. This also looks at factors, such as age group, to be targeted.

From these considerations suggested gaps are identified, and filling these gaps represents opportunities.

Drinking water and WASH programmes.

Mapping priority areas. From mapping the prevalences of anthropometric indicators— see figures 3.1, 3.2, and 3.3 – the geographic pattern of child malnutrition can be seen. Poor water supply is causally related both to stunting (for example, repeated episodes of diarrhea slow linear growth), and to wasting (recent diarrhea is usually the main correlate of reduced weight-for-height). Underweight summarizes these in a sense, although it is generally more highly correlated with stunting. Where there is doubt as to whether to base decisions on stunting or wasting, a useful compromise is to start by considering underweight. In fact, considering drinking water is a case in point.

Stunting is more extensive in the northwest of Ethiopia – Tigray and Benishangul-Gumuz (B-G) – and also high in southern SNNP, and in four zones in the centre of the country. On the other hand, in terms of stunting Somali and Affar look better off. We see much the opposite from the wasting map, which show that the lowland dry areas (Affar and Somali) have the highest wasting

levels. These are not inconsistent, but represent different time frames: acute food shortages and limited water supplies are risks for wasting, and these are less acute in the northwest, for example. However, both require improved water as a matter of priority. The underweight map thus may provide better guidance on this than either stunting or wasting – showing both the northwest and the lowland dry areas as priority.

The quality of drinking water was assessed using the DHS data (see methods: poor quality defined as unimproved source), and the extent is mapped in figure 3.5. Areas with poor water source and high malnutrition are seen, for example, to be in southern SNNP, southern Amhara and northern Oromia (the zones in centre-east), and northeast Affar.

The presence of WASH programmes by zone is shown in figure 3.4. This shows limited overlap with unimproved water source, suggesting a first option for retargeting.

However, the goal here is to help improve nutrition, so we need to add prevalences of malnutrition to this process. This additional dimension is not easy to overlay without becoming confusing. Therefore the indication of need has been calculated by combining malnutrition and poor water source; these are then compared with the data on WASH program presence.

The highest priority is proposed as where malnutrition and lack of improved water are both in the highest tertile^{oo}, plus where the program presence is least. This is mapped in figure 3.6, to give the simplest view. This suggests top priority areas mainly in the centre-southwest of the country. The listing and definition of these zones is given in table 3.1. These are:

Priority A zones: SNNP: Shaka zone

Priority B zones: Afar: Zone 5; Amhara: Oromia Zone; B-G: Kemashi, Metekel; Gambela: Zone 1; Oromia: Borena, Ilu Babor, Jimma; SNNP: Guraghe.

Combining these different factors gave a more nuanced list of priorities, including those defined as described above. This is shown in figure 3.7. The detailed definitions used are given in two tables, table 3.1 and table 3.2. An overview interpretation of the map in figure 3.7 could be as follows. The top priorities remain as above, coloured purple, with a priority C added, where some WASH programme presence is reported and there is at least medium need.

The map shows the other side of the picture too, where there are WASH programmes in areas of high or medium need – coloured green – suggesting good targeting. Finally, areas of lower need, where there are relatively good drinking water supplies and less malnutrition are shown in pale blue.

These are the areas suggested for priority from the available data. No doubt this information will be updated, and may not agree with other views of the situation. The maps can be redone (with some effort). An option is to build the capacity to undertake the mapping processes locally, using the procedures we developed (see methods).

^{oo} Or, some say, tercile: anyway means ‘one third’

Design of programmes to impact child nutrition. First, here is a recap of the main findings from the correlational analysis (section 2c) and resources analyses (sections 3b and c) that form the basis of these considerations.

- Both water supply and toilet had a bivariate association with HAZ, as shown in table 2.15 in section 2c, in both younger (< 24 months) and older ($\geq$ 24 months) children. However, when controlling for potential confounders (education, maternal height, and each other^{pp}), the associations were different by age group, so these are treated separately in analysis. However the programmatic implications really apply to all households.
- In sum, unimproved toilet was more important for the younger children and water supply for the older ones.
- The estimated effect size with improved toilet for the <24 months children was about 3 ppts stunting. This significantly interacted with maternal education.
- The estimated effect size for the $\geq$ 24 month group at national level going from unimproved water (surface) to improved was 7 ppts of stunting; however interactions also affect this conclusion, see below.
- Interactions with maternal education were similar for toilet and water supply, as follows:
 - The interaction of toilet with education, in the < 24 month children, was in the direction that only children in households where mothers had some education did HAZ improve significantly with improved toilet. In this case, unusually, the result was somewhat different with stunting prevalences, which improved in both cases; with an effect size of about 6 ppts.
 - The interaction with maternal education (none vs some) and water supply was highly significant ($p=0.000$) for the older age group, but not for the younger group ($p=0.727$), both controlling for potential confounders. For the older group this was in the direction that improved water was only associated with less stunting in the educated group; here the effect size (adjusted) was 14 ppts in the educated group, and 5 ppts in the uneducated.
- Breaking down stunting by different water sources (piped, public tap, well, surface/rain) showed no change in stunting going from surface to well water, and only when the water source was public tap did stunting fall, then further with piped sources. In the overall population 73% of households have surface or well water, so there is a long way to go for improved water to have its impact on nutrition. However, it may be important to take account of this in planning.
- This relationship was generally similar in most regions; it certainly was not driven by one or two; interaction with education was most significant in Affar, B-G, and SNNP.
- No significant interaction between poor water supply and no toilet was found.
- The WASH programmes cover an expanding portion of the country (see table 3.23 in section 3c), at about \$16/person (\$1.6 billion for the country – this seems low).
- Donors supported 156 WASH projects for \$175 million in 2013.

^{pp} Controlling for maternal height makes a substantial difference, moreover unmasking associations not otherwise seen; this needs further investigation, but these should not change the overall conclusions.

The implications for WASH programmes in terms of enhancing their likely impact on nutrition seem to be as follows.

First, water supply appears more important than sanitation from the perspective of child stunting, although the younger age group more affected by toilet is the most vulnerable overall. The result that water supply's relation to stunting has a threshold effect, so that stunting only falls with supply improved to the extent of public tap, is not what would have been hoped, as this means that about 75% of households would need to benefit from water supply development. But this is what the evidence says.

Second, the finding that unimproved toilet and water supply only affects child nutrition among the more educated suggests that there are behaviours that affect hygienic practices and the way that water is used. This suggests, first, that further enquiry is needed to understand better the behavioural differences. Second, an educational component needs to be added to water supply development projects to change practices so that the potential for improving child growth is realized. This behavioural change communication could also be delivered by local health and nutrition workers, where there is water supply development. The same may apply to hygienic practices and sanitation improvement, and also benefit from further enquiry.

These findings also suggests, however, that aiming to change behaviours on water use will not have much effect in the *absence* of improved water supply, moreover improved to the point of installing public taps. Thus such a behaviour change component could be focused on situations where there is water supply development. In these the evidence is that the uneducated households would be the ones that would benefit, but targeting in this way might not be feasible.

Interestingly, there is a project category for water supply/education in the donor (DAC) reports (code=14081), estimated as \$760,000 in 2013. Possibly this budget item could be expanded and elaborated to support the needed behaviour change communication (when this is defined by further enquiry) as a module in water development.

The initial action on this would be to review the current plans for water development and establish links with the nutrition plans.

Infant and Young Child Feeding (IYCF) practices and Community-based Nutrition (CBN) programme

The effect of non-optimal IYCF practices varies by age, as do the actual practices themselves. The common feature is that interventions aimed at changing any of these practices would be primarily through community health and nutrition workers in the CBN – presently the Health Development Army. While these practices may vary by region – especially by livelihood – it is not crucial at this stage to distinguish these, and the mapping refers to IYCF practices as a whole. The process of tuning the behavioural change interventions to the priority practices, by child's age and local habits, would be important – indeed, a significant opportunity for enhanced impact

– and should be considered in a next iteration. Having said that, we can point to the specific behaviours that could be optimized, as discussed below.

The opportunities and likely impact are summarized in figures 2.56A and 2.56B, showing the relation of specific behaviours to age. These behaviours are:

- Early initiation of breastfeeding (important at birth)
- Consumption of solid, semi-solid, or soft foods (from 6 months)
- Minimum meal frequency (around 6-18 months)
- Minimum dietary diversity (from about 18 months).

Mapping priority areas The interpretation of the maps on IYCF practices is analogous to that on WASH in the previous section, so the details common to both will not be repeated.^{qq} The maps on IYCF are in figures 3.30, 3.31, 3.32, 3.33, 3.34, 3.36, and 3.37. These comprise two sets of maps, the first uses IYCF specific programs and the second uses presence of CBN.

The programme coverage map, based on REACH data for 2013 on IYCF projects, shows low coverage in the west of the country, and in Somali and Affar.

The indicator used for IYCF practices for the present purpose is minimum dietary diversity; this is the practice that is most widely problematic, and improving it from non-optimal to optimal (3 or more different foods a day – see methods for further explanation of why the 4 or more foods definition is not used) is estimated to give a substantial impact – at population level up to about 10 ppts reduction in stunting. The distribution by zone of the estimated % of children (after 12 months of age) getting less than this minimum is mapped. (Note that the %s are very low even in the better zones – the cut point is 16%, so best off is > 16% with this practice optimal – see methods for further mapping explanation.) From the dietary diversity map it is clear that Affar and Somali together have the worst practices; some of this may well be from the traditional pastoralist lifestyle, but recall that livelihood (as measured in the DHS eco-zoning data) itself unexpectedly did not account for much difference in child growth. The northwest of the country also had poor dietary diversity, but in this case is also reported as having most programmes.

Combining these then by need suggests highest priority to Affar and Somali, and also southern SNNP (where pastoralism is also common). Areas in Gambela and western Oromia are also of priority.

There is a limit however to how far targeting is relevant, since throughout the country dietary diversity for young children is a major constraint. Even the supposedly better-off areas in this respect may have less than 20% of children meeting dietary diversity norms. Probably a policy to address this would not focus greatly on targeting, but on ensuring that interventions to improve dietary diversity are prioritized wherever the CBN is operating.

^{qq} It is suggested that the mapping section for WASH (in the previous few pages) should be read before this section.

Design of programmes to impact child nutrition. Two aspects can be considered here: the specifics of improving IYCF, and the broader questions of CBN impact, for which IYCF is an indicator of the broader CBN programme. (Note that breastfeeding itself could not be assessed, as explained in methods, due to the habit of weaning children based on size rather than age.)

The opportunity to improve effectiveness of the CBN in addressing IYCF practices would involve more specific targeting of messages to mothers appropriate to the age of their children. The four practices assessed – as noted earlier – are relevant at different ages: for example, consumption of solid foods (etc.) after 6 months, mitigating the problem of too-late introduction of these. The ages at which the evidence suggests that these four practices have most impact is easily seen from figures 2.56A and 2.56B.

Some regional differences were seen in IYCF, of which the more important are as follows.

- Early initiation of breastfeeding – putting the infant to the breast within one hour of birth – was lowest in Amhara (38%) and highest in SNNP and Harari (about 70%) (see table 2.49. The bivariate association with HAZ was significant ($p=0.034$, table 2.51), and was modified by child's age (even within the 0-2 month group). However, the association with stunting is not so important here, as we know from other evidence that this practice is beneficial and should be promoted. More useful perhaps is that up to 60% of infants, depending on region, may not have been put to the breast as early as they should be.
- Exclusive breastfeeding under 6 months. Although the association with child growth cannot be analysed, breastfeeding practices can be. At 0-1 month, 69% of infants are reported as exclusively breastfed, falling to 31% at 4-5 months (table 2.54). This too varies substantially by region: for exclusive breastfeeding during 0-5 months, from 20% in Somali to 72% in Amhara.
- Continued breastfeeding at 1 year is almost universal (see table 2.57). This applies to all regions except Affar and Somali, where the estimate at 12-15 months is about 75%.
- Introduction of solid, semi-solid, and soft foods (SSS foods). First, at 3-5 months 18% of children were reported to be already eating these foods, with no significant drop in HAZ; but this is confounded, as for other breastfeeding-related estimates, by IYCF depending on child size rather than age. By 6-8 months, 50% of children are getting SSS foods, and 76% by 9-11 months; these have significantly better HAZ (see tables 2.59, 2.60, and 2.61). Thus 50% of children who should have SSS foods by 6-8 months are not getting them, and even at 9-11 months 25% are not. This varied, for 6-8 month children, from less than 25% getting SSS foods in Affar and Somali, 50% or more in Gambela, B-G, and Harari. Introduction of SSS foods was interactive with education, such that late introduction had no effect in educated households. This interaction is potentially 'equity-positive', in the interventions to improve this practice will preferentially help the worse off (or uneducated) (see figure 2.60).
- Minimum meal frequency for young children is usually defined as 3 meals per day. This was met for about 50% of children of 6-23 months (73% by 21-23 months), see table 2.65. Again Affar and Somali are the lowest, at 15-26%, and the other regions range from 33% (Gambela) to 58% (Oromia). Meeting minimal meal frequency was associated with better HAZ up to 11 months, and this remained significant ($p=0.016$) for 6-8 month

children controlling for the usual potential confounders (table 2.67A). Again a significant ($p=0.007$) interaction with education was seen, also equity-positive.

- Minimum dietary diversity was here defined as 3 of a possible 6 food groups (see methods). The most striking aspect is how few young children meet even this low criterion – at 6-23 months, of breastfed children 17%, and non-breastfed 30% (see tables 2.69 and 2.70). Moreover the pattern is fairly uniform by region, most being around 15-20%, and actually appears to be getting somewhat worse through time. Minimum dietary diversity had a significant bivariate association with improved HAZ at certain ages between 9 and 23 months, and the difference was always in the expected direction; the relation persisted controlling for potential confounders at 15-17 months ($p=0.070$) and 18-20 months ($p=0.059$). In this case, the implications for intervention include both behavioural change, and the need for a better supply of diverse foods – a possible link to agriculture and marketing.
- Combining these latter two indicators to give a measure of ‘minimal acceptable diet’, as suggested by WHO, gives similar results (see tables 2.75 and 2.76).

A further aspect of designing effective programmes concerns the organization of the programme itself. Evidence is accumulating that community-based programmes, like the CBN, can have a measurable impact on child nutritional status, if they meet certain criteria. Some of this evidence comes from an evaluation of the CBN between 2010 and 2012, given in a report to UNICEF and in the mid-term review (for the World Bank) of the CBN.^{2,3} This contributed to a review by WHO of the effectiveness of the many large scale community based programmes that were identified – 60 in total, of which 11 had nutritional impact evaluation data.⁵

An important parameter in producing impact is the number of community workers per household. On a part-time basis, about 1 field worker: 20 households is associated with significant impact, and the CBN at that time was well within this range. A second parameter is the participation rate: while the coverage in CBN woredas was high, the actual proportion of mothers-children participating was only about 30%; this was estimated both from evaluation surveys, and from CBN reported weighing data.⁶ The inference (put forward in the mid-term review) is that increasing participation should be of priority, as much as expanding the overall coverage. Other important factors that must be optimized for impact are training, supervision, remuneration, and incentives.⁷ Given a well-functioning programme, it is estimated that an additional approximately 2 ppts/year reduction in stunting can be achieved.

Poverty and PSNP

The evidence is clear, from Ethiopia and many countries, that poverty (however measured) is associated with reduced child growth and malnutrition. Using the no-assets measure in EDHS 2011, the difference is 5 ppts in stunting. This is discussed in section 2b. We should also recall that, important as poverty is, the trends in stunting showed that children in the poorest households improved at the same fast rate as those less poor. Poverty is a key cause, but child nutrition can improve even among those for whom poverty stays the same.

While most development programmes have reducing poverty as an objective, this is usually long-term, and indirect with respect to malnutrition. One of the most important direct

interventions, providing cash or food to vulnerable households, is the Productive Safety Net Programme (PSNP). This is similar to cash transfer programmes elsewhere, and is now introducing some conditionalities, thus evolving towards programmes that have shown much success in Latin America, and in some Asian countries, referred to as Conditional Cash Transfer Programmes (CCTs). The global evidence is still coming in, and there is little doubt that these programmes contribute to the health and nutrition of women – hence to reducing IUGR – and children.⁸

Mapping priority areas. The presence of PSNP, from the REACH data of 2013, is mapped in figure 3.23. The programme has most presence in the eastern part of the country, least in the west (see figure 3.23). This hardly corresponds to the pattern of poverty, possibly more to food insecurity.

Using the usual overlay method, the highest priority zones are thus in the west, with a top priority to North Shewa zone in Oromia (dark purple) (see figure 3.25). Combining all data to give different priority levels (figure 3.26) suggests that PSNP projects are well targeted in Somali and Affar, of medium priority in the middle of the country, and high priority in the west.

Zones of high and medium priority are listed in table 3.9: as well as North Shewa, these include: B-G: Asosa, Kemashi, Metekel; Gambela: Zone 1; Oromia: Ilu Babor; SNNP: Shaka, South Omo.

Design of programmes to impact child nutrition. No doubt PSNP administrators (and donors) have estimates of the amount of resources, as food or cash, that are distributed through the programme. One of the set of policy options is to expand the programme geographically, and the previous section may contribute to that. Other factors concern eligibility criteria, and added-on activities like the conditionalities.

For eligibility, it is understood that pregnant women can benefit without a work requirement, which is obviously a good policy. Early identification of pregnancy, leading to early transition from public work to direct support is important, and is to be a target for improved implementation in the fourth (new) phase of PSNP. Households with malnourished children under five years of age will also be eligible for temporary support under PSNP, with conditionalities required for receipt of transfer.

Conditionalities in many CCT programmes require mothers to ensure their children are immunized, and often that they attend seminars or training sessions on good health, nutrition, and hygiene practices. This would be a major opportunity for enhanced nutrition impact, and is represented as such in the design of the new phase of PSNP. For example, attendance in community nutrition behavioural change communication sessions may be used as a substitute for public works. Communities may also identify public works and livelihoods with the potential to improve nutrition, further enhancing community access to facilities and/or services with the potential to improve nutrition. It should be considered that both the IYCF practices, and the use of improved water, could be promoted through this mechanism, as the HEWs and HDA serve as

the major delivery mechanism of all of these services. This in turn would need those responsible for nutrition and the CBN to contribute materials designed for this purpose, and possibly personnel to conduct the information sessions.

Health services and nutrition.

In the analyses reported in section 2c, the effect of access to health services on child nutritional status was separated into those whose importance was around the time of birth, and analyzed among 0 to 23 months; and then to children 24 to 59 months.

Health services for birth to 23 months. The factors for which suitable variables were available for birth-23 months were: place of delivery (home, public facility, private facility) and antenatal care (ANC).

In 2011, only 11% of deliveries were in a facility (table 2.78), up from 5% in 2000. Regionally, Gambela, Harari, and Dire Dawa were better served, still with 60-70% home delivery. More than half the pregnancies (56%) did not include any ANC (table 2.91); most of those that did were attended by a nurse/midwife (tables 2.84). In Somali and Affar about 30% of ANC involved a health professional, in Tigray 65%, and in Addis Ababa 97% (table 2.85). The pastoralists were lower in access to ANC, but surprisingly by only a few ppts – pastoralists with ANC, 30%; agriculturalists, 43%; agro-pastoralists, 39% (table 2.86).

Home delivery was strongly associated with lower HAZ and higher stunting – it should be stressed that home delivery here is a proxy for general access to health services. Receipt of ANC was associated (bivariate) with better HAZ, more so when controlling for child's age ($p=0.000$) (table 2.87). Thus the case is strong that getting better access to health services leads to better child growth in the youngest age group.

However, the associations of home delivery and ANC use were modified by SES (by sanitation and education respectively, with significant interactions controlling for potential confounders; see figures 2.64, 2.65, 2.66 and 2.67. As usual, these were in the equity-negative direction – better access to health services (indicated by these proxy variables) improved child growth only for the better-off, and had no effect for the poorest. This suggests that there are other factors, which could be physical access and/or behavioral, that need to be investigated. This is important given the huge effort in extending health services, which may need additional components in order to have maximum benefit for the poorest children.

Health services for 24 to 59 months The indicators used here are ownership of health card, and measles immunization – both taken as proxies for access to health services. Treatment of children's diarrhea was also included. These indicators were much less associated with child growth. For instance, there was no association with receipt of measles vaccine, nor with health card ownership. An association was found with treatment for diarrhea (results not shown), but as

this was on a subset of the sample (those who had diarrhea in the last two weeks) this was not pursued.

Ownership of health cards is reported by 56% of the mothers in the DHS survey of 2011. This varies greatly by region (table 2.97), not so much by livelihood. Regionally, 91% have health cards in Tigray, less than 30% in Affar and Somali. These percentages are similar for measles immunization, 58% of children 24 months and over reported immunized, with comparable regional differences.

In the 2011 sample, 10% of the children had had diarrhea within the two weeks prior to the survey. Of these 62% had no treatment. This indicator however was rather constant across regions (table 2.105).

Mapping priority areas. No programme data was available to indicate extent of health services development by zone, so we were unable to map this in the same way as the other programmes. Health workforce data are available at the regional level, as described below. In general, there were no clear relationships (in either direction) between the risk indicators (home delivery etc) and the workforce on a per population basis.

Health workforce data. There are about 16,000 health posts in total, and the numbers by region are given in table 4.1. The population on average per health post, calculated from population data is shown in figure 4.1, and in terms of health workforce personnel per 10,000 in figure 4.2.

The national average is 1.74 health posts per 10,000. To put this in context, we could assume 2 staff per health post. This gives 3.5 workforce personnel per 10,000 population. Workforce is defined by WHO as density of doctors, nurses and midwives; here, the workforce personnel at health posts are HEWs. Ethiopia's estimated density of health workforce put out by WHO is 3 per 10,000,⁹ which WHO suggests comparing with a minimum threshold (from the World Bank) of 23 health workforce personnel per 10,000, more than 10 times the Ethiopian figure. However, the aim of having health volunteer workers (HDA) to fill the gap – at a ratio of 10-20 per HEW – expands this number greatly. If we use a factor of 10, then the density estimate comes up to nearly 20 personnel per 10,000 population. This also corresponds with the density of community health workers – 1:10-20 households (part-time) – needed to have an impact on child nutrition.⁷

In terms of regional distribution, the data in the figures shows that Tigray and Afar are worse than the national average, B-G and Gambela better. Dire Dawa and Harari also appear poorly served, but this should be checked. Dire Dawa is a city administration and Harari has a more urbanized population, thus likely served by health centres, rather than health posts.

Much then depends on the knowledge and skills of the volunteer health (and nutrition) workers. Reliance on lay health workers (as these are sometimes known as, or relais in W Africa)¹⁰ – task shifting, to free up time of qualified health practitioners – is being tried in a number of situations.¹¹⁻¹⁴ The experience seems to be mixed, and much depends on quality of supervision, training and incentives.

While clearly there are shortages of highly qualified health workers, the current strategy appears to be getting to the density levels considered to be adequate, if the HDA or community health workers can provide the quality needed to fill the gap.

An issue for nutrition concerns the time availability, priority, and knowledge of the frontline workers concerning nutrition. Specifically, the training should be reviewed, and there may well be an opportunity to have greater effect on child nutrition through giving nutrition a higher priority, and ensuring that training is relevant. In this context, matching messages on IYCF to children's ages, as suggested by the results shown in figure 2.56 (Effect of improving IYCF practices at different ages).

Design of programmes to impact child nutrition. Access to health services is still a considerable constraint on child health and growth, and is a gap that the Health Extension Programme (HEP) is steadily filling. We can support the need for expanding coverage with these nutritional data, and suggest priorities for expanded coverage, as above. As health services expand, there are programmatic options that would benefit child nutrition over and above the services routinely provided – opportunities for increasing impact. Here are some suggestions.

The health post provides the base for the CBN, and the HEW supervision and guidance for the community-based workers, now the HDA. Providing this support is crucial for the CBN, and should remain an important function of the HEW. Where the health post is not present, i.e. among pastoralist populations, the mobile health workers should receive equivalent supervision and guidance on CBN components, including weighing and counselling. Among agro-pastoral populations, the HEW support should be provided to the Mother to Mother support groups, equivalent to the HDA in agrarian regions.

The referral system for the CBN, whereby sick children and those becoming malnourished – identified by the weighing program, or otherwise – get timely treatment either in the kebele or the health post, is important both for the welfare of the child and for the credibility of the CBN. This should also function for pregnant women, facilitating access to ANC. For this to work, the quality of the facilities and of the health workers needs support; for example women will not seek ANC if they see no purpose; nor will they travel and wait in line if their children do not get adequate treatment.

The HEW and the HDA provide a main route for getting messages out for changing behaviours that benefit child nutrition. This applies to the changes discussed in the earlier section for improving IYCF practices. It could also apply when water supplies are being improved.

The weighing programme should continue, as a means of identifying children becoming malnourished (for prevention), and as one means of communication with mothers. (The argument that weighing programmes have no value as they do not themselves prevent malnutrition is facile: we don't expect taking a child's temperature to see if s/he has a fever to cure the disease, but the information is important for deciding what to do; the same applies to weighing a child and using a growth chart.) It is also important that the summarized results from

the weighing programme are considered at the health post level, and are communicated up through the administrative system.

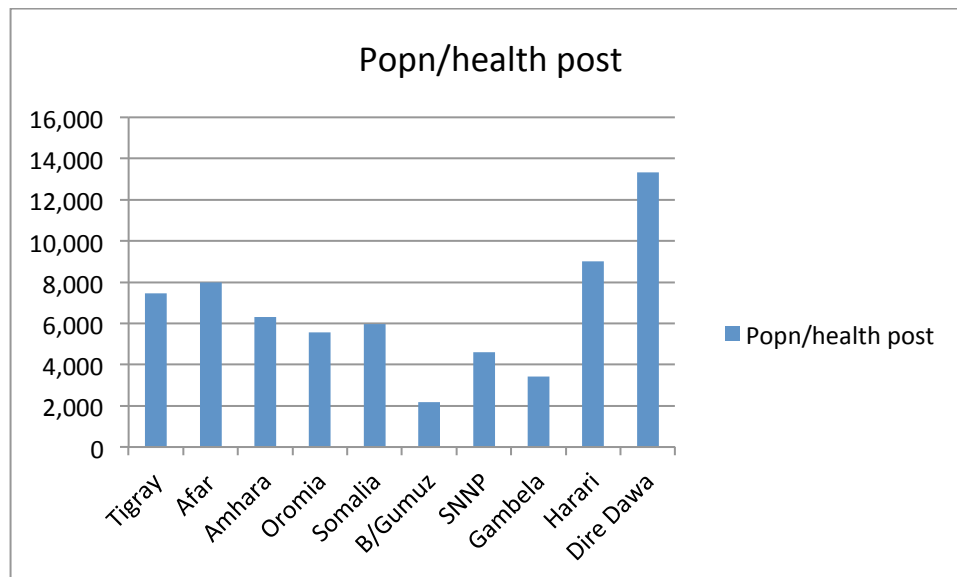
The implementation of these nutrition activities through the health system requires some resources, mainly for equipment and training. Equipment includes weighing scales, including spares, and growth charts. Health cards themselves can record children's growth, and contributions to these from the nutrition resources could be considered. Much depends on the content of training. The HEWs themselves need a knowledge of nutrition, and the capacity to train and supervise the HDA. Ensuring that the HEWs training includes appropriate coverage of nutrition programme issues (and the manuals for that) would be an important step. Similar considerations apply to the content and materials for the HDA training.

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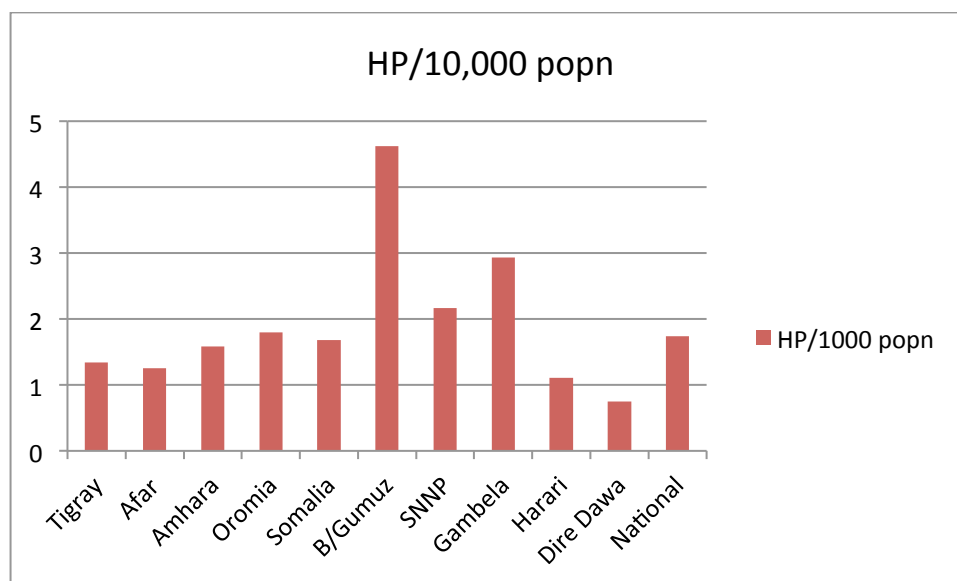
4. Gaps and Opportunities – Direct nutrition interventions – Figures

Figure 4.1. Average population served by a health post, by region.



Calculated from: CSA (2015) and FMOH, PPD (April 2015).

Figure 4.2. Health workforce per 10,000 population, by region.



Calculated from CSA (2015) and FMOH, PPD (April 2015).

4. Gaps and Opportunities – Direct nutrition interventions - Tables

Table 4.1. Numbers of health posts by region.

		Health Posts		
		Func	Not Func	Total
1	Tigray	704	0	704
2	Afar	214	17	231
3	Amhara	3,242	0	3,242
4	Oromia	6,165	0	6,165
5	Somali	846	68	914
6	Benishangule	321	71	392
7	SNNPRS	3,869	180	4,049
8	Gambella	85	39	124
9	Harari	22	3	25
10	Diredawa	31	0	31
11	Addis Ababa	NA	NA	NA
12	Federal	NA	NA	NA
Total		15,499	378	15,877

Federal Ministry of Health, Policy Planning Directorate (April 2015). FMOH, PPD. Addis Ababa, Ethiopia.