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Welcome to the USAID/ENGINE Symposium

Welcome to the USAID/ENGINE Symposium being held June 27-28, 2016 in Addis Ababa at the Hilton Hotel.

As part of the USAID/ENGINE program’s rigorous research and learning agenda, researchers and students from Tufts University and its partners Jimma University, Hawassa University and EPHI have developed and implemented several studies that are examining the linkages and relationships of agriculture to nutrition including but not limited to policy, service provision, better understanding the outcomes that need to be achieved and understanding the effectiveness of intervention strategies and approaches in reaching the intended target. The research and learning agenda also aims to increase capacity in the realm of nutrition policy and programming research with eight PhD students (Ethiopian) utilizing data generated from the learning agenda for their dissertations.

The objectives of the Symposium are to disseminate some of the key findings that are emerging from USAID/ENGINE’s rigorous research and learning agenda that is being led by the Friedman School of Nutrition Science and Policy at Tufts University.

About USAID ENGINE Program

The Empowering New Generations to Improve Nutrition and Economic opportunities (ENGINE) Program, is USAID’s flagship multi-sector nutrition project in Ethiopia which builds upon the Government of Ethiopia’s National Nutrition Program as well as the U.S. Government’s Global health and Feed the Future Initiatives. The program aims to decrease maternal, neonatal and child mortality by improving the nutritional status of women and children less than 5 years through sustainable, comprehensive and coordinated evidence-based interventions in four major regions of Ethiopia. The core initiative of this large-scale project (2011-2016) is to prevent undernutrition in the first 1000 days starting from pregnancy through the age of 2. Save the Children leads the implementation of ENGINE with its partners Tufts University, JHPIEGO and Land O’Lakes. The objectives of ENGINE including strengthening capacity to institutionalize nutrition programs and policies, improving the quality and delivery of nutrition services, improving community based nutrition care practices and the adoption of a rigorous and innovative research and learning agenda.

The USAID ENGINE Research and Learning Agenda

Tufts University leads the objective of the development and implementation of a rigorous and innovative research and learning agenda partnering with local institutions including Jimma University, Hawassa University and the Ethiopian Public Health Institute (EPHI). The component/objective allows ENGINE the unique opportunity to provide decision makers with information to enable them to make policy decisions around programs, on key nutrition concerns and their management and alleviation at a population level and the quality and delivery of services, among others.
The ENGINE research and learning agenda was established at a national multi-stakeholder research meeting held in Addis Ababa in March 2012. The aim of the meeting was to identify and prioritize the main maternal and child nutrition and health related research gaps in Ethiopia. The stakeholders identified 19 maternal and child nutrition and health related research questions of particular interest or need. These priorities can be grouped into three thematic areas including 1. Policy (National and Sub-national) and Service delivery, 2. Understanding the Outcomes being targeted by Policies and Programs and 3. Understanding effectiveness within the context of program implementation.

The ENGINE research partnership developed several studies to address the gaps and priorities identified in the three thematic areas. These include two large longitudinal observational studies, the Agriculture-Nutrition Panel Study and the Birth Cohort Study and several other studies using secondary data sources such as the Ethiopian Demographic Health Surveys and the Ethiopian Household Income Consumption and Expenditure Surveys. The learning agenda thematic areas and illustrative research questions are presented in Box 1.

**Box 1: ENGINE Research and Learning Agenda Thematic Areas and Research Questions**

1. Policy Drivers and Service Provision and Delivery: What do we know?
   - How can nutrition policy be strengthened in Ethiopia to enhance nutrition? What are the key opportunities and barriers to multi-sectoral nutrition strategies; how can we improve this coordination?
   - What are the barriers and facilitators for multisectoral implementation at woreda and regional level in Ethiopia?

2. Outcomes research: What is the current status of outcomes that are policy and implementation targets including factors that facilitate or impede addressing outcomes
   - What are the contributing factors of stunting by region?
   - What are the usual dietary patterns, purchasing behaviors and micronutrient intakes by region?
   - What are intra-household allocation practices within food insecure households (vs. food secure households) and how do they affect IYCF feeding and other caring practices like health-seeking behaviors?

3. Understanding Effectiveness within the context of Program Implementation
   - What is the added effect of a set of nutrition interventions to a commercialization for small holders program on consumption, nutrition outcomes?
   - What is the added effect of strengthening livelihoods on maternal and infant nutrition and health outcomes?
   - What factors are associated with adherence/participation in nutrition programs?
   - What is the effect of nutrition interventions (direct or indirect) on maternal and infant nutrition and health outcomes?
Oral Presentations

Session 1: What do we know about maternal nutrition in Ethiopia?

Factors associated with low Mid Upper Arm Circumference in pregnant women in Ethiopia

Shibani Ghosh, Meghan Kershaw, Kathryn Spielman, Kidane Ayele, Yitbarek Kidane, Krista Zillmer, Ashish Pokharel, Jeffrey K. Griffiths and Tefera Belachew

Background: Mid upper arm circumference (MUAC) in pregnant women is significantly associated with low birth weight and pregnancy weight gain is associated with infant weight-for-age, length-for-age and weight-for-length. The aim of this study was to examine factors associated with low MUAC in pregnant women in Oromia region of Ethiopia.

Methods: Data used in the analysis are from the first time point, which is the recruitment time point (recruitment of pregnant women) in the ENGINE birth cohort study and include, the use of antenatal services, maternal anemia, food security status, maternal literacy and numeracy, maternal dietary diversity (Minimum Dietary Diversity Score), household wealth index, crop production diversity, livestock ownership diversity and livestock product diversity. Descriptive statistics, means and standard deviations were generated and bivariate relationships tested followed multivariate logistic regression modeling. Standard errors were clustered at the kebele level and interactions explored.

Results: Every increase in wealth index quintile lowered the risk of MUAC < 23 cm by 11%. A literate woman has a 20% lowered odds of MUAC < 23 cm compared to a non-literate woman while a numerate woman has a 30% lower risk of low MUAC. Altitude-adjusted anemia, HFIAS, and pregnancy trimester, fasting were all significantly associated with increased odds of MUAC < 23 cm with OR of 1.3 (p=0.004), 1.04 (p=0.000), 1.27 (p=0.001), 1.84 (p=0.000) respectively.

Conclusions: Women with MUAC < 23 cm are at a higher risk of poor birth outcomes. In a longitudinal study, we find that anemia, food security, trimester time period, the practice of fasting and distance to health services increases the odds of a low MUAC, while wealth, literacy, numeracy and access to a market have a protective effect.
Understanding Service Provision around Health and Nutrition in Select Woredas of Oromiya Region in Ethiopia

Meghan Kershaw, Ashish Pokharel Kidane Ayele, Yitbarek Kidane, Jeffrey K. Griffiths, Tefera Belachew and Shibani Ghosh

Background: Ethiopia, a country of 94.1 million people, with nine regions and two city administrations and a population growth rate of 2.6%, has high rates of infant mortality (52 per 1000) and high rates of malnutrition in infants and young children. The Government of Ethiopia has accelerated its efforts to enhance good nutrition practices through health education and service provision. The Health Extension Programme (HEP) has incorporated nutrition within the basic health service package since 2006, a key issue to understand is the quality and capacity to implement the nutrition components of the health service package.

Objective: To gain understanding of the knowledge, attitudes and practices of frontline workers (FLWs) in select woredas in Oromia region.

Methods: The study areas were three woredas (Gomma, Woliso and Tiro Afeta) in the Oromia region. Five hundred sixty FLWs (155 Health Extension workers, 206 Health Workers and 199 Development Agents) were interviewed. Data were collected electronically on knowledge of nutrition situation in the area, available program and health services, training and the work environment, constraints in service provision, and knowledge and attitudes. Interviews were conducted from March – May 2015. A follow-up interview was conducted March-May 2016. Analysis was conducted using STATA and Microsoft Excel. The three cadre of workers include health workers (HW), health extension workers (HEW) and development agents (DA).

Results: Sixty percent of all respondents in Tiro Afeta, 51% in Gomma and 40% in Woliso were women. Respondent age ranged from 26-27 years. Respondents had lived in Gomma and Woliso for a median of five years and 3.5 years in Tiro Afeta.

Nutrition Situation Awareness: 37% of all frontline workers considered nutrition a problem in mothers in their catchment area. At the woreda level, 75% of FLWs in Tiro Afeta, 25% in Gomma and 35% in Woliso reported nutrition of mothers as a problem. A total of 41% considered nutrition a problem in infants and young children in their area (24% in Gomma, 82% in Tiro Afeta and 39% in Woliso). Specifically by cadre, we find that 44% of Development agents, 30.5% of Health Extension workers and 48% of health workers considered nutrition a problem in infants and young children while 42% of DAs, 26% of HEW and 41% of HWs considered nutrition a problem in reproductive age women. Thus the highest respondent rate was in Tiro Afeta, in contrast, examining the prevalence of low mid upper arm circumference in pregnant women (Low MUAC), we find that while the prevalence is highest in Tiro Afeta (55%), was also relatively high in both Gomma (35%) and Woliso (42%).

Service Usage: In both Gomma and Woliso, between 92 to 98% of DAs, HEW and HWs reported that household frequently used their services (either agricultural or health) but only 54% of DAs, 68% of HEWs and 75% of HW reported being able to meet the needs of the households. In the case of Tiro Afeta, only 58% of DAs, 70% of HEW and 82% HW reported regular use of services by households with only 30% of DAs, 55% HEWs, 57% of HWs reporting being able to effectively meet the needs of the population. In the case of Gomma, 92% of DAs, 95% of HEWs and 98% HW reported that households regularly use their services however 73% of DAs, 92% of
HEWs and 84% of HWs reported being able to effectively meet the needs of the population. Finally in Woliso, between 97-98% of DAs, HEWs and HWs reported that household regularly use their services however only 50% of DAs, 47% of HEWs and 73% HWs reported that they were able to effectively meet the needs of the population.

Training: Most agreed that there was need for refresher training in their field of expertise (all cadres) (70% Gomma, 50% in Tiro Afeta and Woliso). Specifically 47% of DAs, 54% HEWs and 70% of HWs agreed that there was need for refresher training within their field. At the woreda level this translated into 58% DAs, 56% HEW and 92% HW in Gomma, 42% DAs, 50% HEW and 60% HW in Tiro Afeta and 39% DAs, 54% HEW and 53% HW in Woliso. We find that 35% of DAs, 83% HEW and 91% HW had received nutrition training though this training could have been received anywhere in the past 6 months to greater than 5 years. At the woreda level, 41% DAs, 96% HEW and 98% HW in Gomma, 20% DAs, 91% HEW and 91% HW in Tiro Afeta and 38% DAs, 61% HEW and 84% HW in Woliso had received nutrition training.

Nutrition and Health Education and Counseling: Fifty eight percent of health workers confirmed providing nutrition and health education (across all woredas). By woreda, 60% and 80% Health workers in Gomma and Tiro Afeta respectively confirmed provision of health and nutrition services and counseling compared to 46% in Woliso. Despite high nutrition knowledge (96% of all health workers correctly answering 4 nutrition questions), only 57% Health workers in Gomma, 44% in Tiro Afeta and 60% considered provision of nutrition education and counseling was their responsibility. Furthermore, we found that 90% of health workers in Gomma, 55% in Tiro Afeta and 92% in Woliso stated that the time they have to spend on nutrition and health counseling/education was not sufficient.

Conclusions: Several issues and challenges have been identified in the first survey of FLWs, with special focus on the issues and challenges around health workers and health extension workers. This includes insufficient time for provision of nutrition and health counseling by health workers, need for refresher training across all the cadres, that nutrition training was mostly provided at the kebele level. There was low involvement in Woliso in the provision of health and nutrition education with a high number of health workers perceiving that nutrition was not their responsibility. In two of the three woredas, low percentage of FLWs considered nutrition as a problem despite the prevalence of low MUAC in pregnant women in these woredas being relatively high. Additional analyses are being conducted to examine the effect of work environment, further incentives and disincentives towards service provision. Separate analyses are being conducted in understanding service provision, incentives and dis-incentives around the activities implemented by development agents.
Prevalence and Predictors of Anemia: Women of Reproductive Age in Ethiopian

Dilnesaw Zerfu, Tefera Belachew, Pernille Kæstel, Tsinuel Girma and Henrik Friis

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Prevalence and Nutritional, Obstetric and Socio-demographic Determinants of Prenatal Depression in South-West Ethiopia: A Community Based Study

Yitbarek Kidane Woldetensay, Tefera Belachew, H.K. Biesalski, Eva Johanna Kantelhardt and Veronika Scherbaum

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Session 2: What do we know about acute malnutrition in Ethiopia?

Nutritional and Health Related outcomes of children treated for severe acute malnutrition in a community based program, Jimma Zone, Ethiopia

Tsinuel Girma, Alemseged Abdiissa, Yesuf Getu-Philip James, Kate Sadler and Paluku Bahwere

Background: Severe acute malnutrition (SAM) is a major public health problem in Ethiopia and responsible for over half of deaths among Under-5 children. Recently, Ethiopia has seen significantly improved coverage of the community-based management of acute malnutrition (CMAM), mitigating SAM and reducing child mortality by 60 percent in two decades and reversing malnutrition trends. However, there is limited data on long term outcomes following discharge from SAM treatment. This study therefore aimed to determine the survival, nutritional and health outcomes of children who had recovered from SAM.

Methods: This prospective cohort study was conducted in Jimma zone on post-SAM cases (n=203) and their non-wasted, age- and sex- matched controls with no particular intervention. A one-year follow up was done monthly and data on nutrition status, morbidity and vital status were collected at each visit. Data on body composition and haemoglobin were collected at enrolment and six months later.

Results: The study indicates that post-SAM children had a better morbidity and mortality profile than those of similar cohorts followed in other countries. However, when compared to non-wasted controls children from the same community they remained more vulnerable and had more incident episodes of acute malnutrition and infectious diseases, and at the end of follow up they had not yet caught up the controls in term of anthropometric indices, lean mass and “cellular health” parameters.

Conclusions: Overall our results indicate that children recovering from SAM and discharged using current criteria still need particular attention during the first three to four months after discharge and that research is urgently needed to determine the appropriate package of interventions that may accelerate catch up growth and complete recovery. There is evidence for fat mass catch-up at discharge from CMAM that was also sustained; this could increase the risk of metabolic abnormalities in the long-term.
Children with Moderate Acute Malnutrition with No Access to Supplementary Feeding Programmes Experience High Rates of Deterioration and No Improvement: Results from a Prospective Cohort Study in Rural Ethiopia

Philip James, Kate Sadler, Mekitie Wondafrash, Alemayehu Argaw, Hanqi Luo, Benti Geleta, Kiya Kedir, Yilak Getnet, Tefera Belachew and Paluku Bahwere

**Background:** Children with moderate acute malnutrition (MAM) have an increased risk of mortality, infections and impaired physical and cognitive development compared to well-nourished children. In parts of Ethiopia not considered chronically food insecure there are no supplementary feeding programmes (SFPs) for treating MAM. The short-term outcomes of children who have MAM in such areas are not currently described, and there remains an urgent need for evidence-based policy recommendations.

**Methods:** We defined MAM as mid-upper arm circumference (MUAC) of ≥11.0cm and <12.5cm with no bilateral pitting oedema to include Ethiopian government and World Health Organisation cut-offs. We prospectively surveyed 884 children aged 6–59 months living with MAM in a rural area of Ethiopia not eligible for a supplementary feeding programme. Weekly home visits were made for seven months (28 weeks), covering the end of peak malnutrition through to the post-harvest period (the most food secure window), collecting anthropometric, socio-demographic and food security data.

**Results:** By the end of the study follow up, 32.5% (287/884) remained with MAM, 9.3% (82/884) experienced at least one episode of SAM (MUAC <11cm and/or bilateral pitting oedema), and 0.9% (8/884) died. Only 54.2% of the children recovered with no episode of SAM by the end of the follow up period. The median (interquartile range) time to recovery was 9 (4–15) weeks. Children with the lowest MUAC at enrolment had a significantly higher risk of remaining with MAM and a lower chance of recovering.

**Conclusions:** Children with MAM during the post-harvest season in an area not eligible for SFP experience an extremely high incidence of SAM and a low recovery rate. Not having a targeted nutrition-specific intervention to address MAM in this context places children with MAM at excessive risk of adverse outcomes. Further preventive and curative approaches should urgently be considered.
Introduction: Anemia among pregnant women is associated with higher risk of low birth weight and both maternal and perinatal mortality. Therefore, it is a critical public health issue. Despite previous studies examining factors associated with anemia in Ethiopia, there remains little consistent and conclusive evidence that can be used to guide policy and programmatic action. The objective of this study was to examine the association between anemia status in pregnant women with various health, behavioral, and socioeconomic factors in pregnant women in Oromia region of Ethiopia.

Methods: Data used in the analysis are from the first time point, which is the recruitment time point (recruitment of pregnant women) in the ENGINE birth cohort study and include maternal health characteristics, food security status, maternal literacy and numeracy, maternal dietary diversity (Minimum Dietary Diversity Score), household wealth index, crop production diversity, livestock product diversity. Descriptive statistics, means and standard deviations were generated and bi-variate relationships tested followed by iterative multi variate logistic regression modeling. Standard errors were clustered at the kebele level.

Results: Household food insecurity access (HFIAS), low maternal MUAC, previous pregnancies, and Muslim were associated with increased odds of anemia, with odds ratios of 1.02, 1.33, 1.49, and 1.66 respectively. For each additional point on the handwashing score scale, odds of anemia were reduced by 11%. Numerate women had 30% lower odds and participation in any form of fasting practice showed a 21% reduction in the odds of anemia.

Conclusions: Women who are anemic during pregnancy are at a higher risk of poor birth outcomes and mortality. We found that household food insecurity, low maternal MUAC, previous pregnancy, and those who identified as Muslim had significantly increased odds of anemia. Numeracy and better handwashing practices significantly reduced the odds of anemia.
Factors associated with birth weight and length in Ethiopia

Shibani Ghosh, Meghan Kershaw, Krista Zillmer, Leslie Wentworth, Kathryn Spielman, Kidane Ayele, Yitbarek Kidane, Jeffrey K. Griffiths and Tefera Belachew

Introduction: The current prevalence of stunting in Ethiopia (DHS 2011) is about 44% (children under five). Factors that are known to be associated with the risk of being stunted include insults that occur in gestation and early life. Low birth weight and length are consistently linked to a higher risk of stunting. The aim of the study was to examine birth weights, length and length for age Z-score in infants born in the ENGINE Cohort study from 2014 through 2015 and understand associated factors.

Methods: Data for this analysis is from the ENGINE birth cohort study and include variables from pregnancy and birth (n=3862) in three woredas of Oromia region. The main outcome variables are birth weight, birth length and length for age Z-score. These include gestational age, maternal MUAC, maternal height, education (literacy and numeracy), anemia status, use of iron supplements in pregnancy, number of antenatal visits, deworming during pregnancy, age, wealth index, maternal diet diversity score (pregnancy and at birth), food security, domestic violence and religion. Descriptive statistics, means and standard deviations were generated and bivariate relationships tested followed multivariate linear regression modeling. Standard errors were clustered at the kebele level and interactions explored.

Results: A total of 98% of live births were observed with few still births and miscarriages across all three woredas. Mean (± SD) birth weight was 3.13 kg (± 0.41) with the highest in Goma and lowest in Tiro Afeta. Prevalence of low birth weight was just under 5%. Birth Length was 49.51± 2.17 while mean length for age Z-score was -0.18 (± 1.15) with 6% stunting in all the infants, the lowest level was observed in 1.9% in infants born in Goma, 5.6 % in infants born in Tiro Afeta and 11% in infants born in Woliso. Linear regression analyses are being conducted to examine the relationship of factors such as maternal MUAC and height, maternal dietary diversity, wealth index, religion/ethnicity, gender of the child, gestational age, wealth index, maternal dietary diversity and number of live births.

Conclusions: Prevalence of low birth weight was lower than national average and other studies. Prevalence of stunting was at 6% in pooled sample with the highest level in Woliso, the negative mean length for age implies early onset in the direction of stunting. These analyses will allow the elucidation of factor associated with Factors mean length, mean birth weight and mean length for age.
Concordance of child feeding and caring practices and its predictors in southwest rural Ethiopia

Netsanet Fentahun, Carl Lachat and Tefera Belachew

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Session 4: Multi-sectoral, nutrition specific and nutrition sensitive
interventions and nutritional status

Impact of ENGINE Livelihood Interventions on most vulnerable households

Elizabeth Drummond, Cherinet Abuye, Carolyn O’Donnell, Kebede Tafesse, Daniel Abbott and Habtamu Fekadu

Background: USAID/ENGINE is a multi-sectoral nutrition project working in 116 woredas in five regions. Nutrition sensitive livelihood interventions in Amhara, Oromia, SNNP and Tigray regions included targeting 15,070 most vulnerable households (MVHHs) for direct support and promotion of homestead gardening, rearing small livestock and poultry, and training and nutrition education to increase production and consumption of diverse foods at the homestead. ENGINE’s external mid-term evaluation recommended that the project conduct periodic surveys to measure key outcome indicators among targeted most vulnerable households (MVHHs).

Objective: To assess the operation and outcomes of ENGINE’s program activities with most vulnerable households, including determining if participation, and the degree of participation, in ENGINE activities leads to improved nutrition practices; the relationship between household assets provided by the project and nutrition practices; and the relationship between gains in household income and nutrition practices.

Methods: Two cross-sectional surveys were conducted among the same 830 project supported vulnerable households, a census of all supported households in 10 woredas, in Nov/Dec 2014 and Sept 2015. Cohort One (C1) (n=483) had been in the project for one year at the time of the first survey and 22 months at the second survey; cohort two (C2) (n=347) had not been reached by the project at the baseline and had been supported for 10 months at the second survey.

Results: Improvements were seen between the surveys in both cohorts in key indicators including, early initiation of breastfeeding (C1 from 55.2% to 61.4%, and C2 from 56.6% to 62.1%), use of IFA (C1 from 58.9% to 63.9%, and C2 from 61.3% to 66.1%), exclusive breastfeeding (C1 from 78.9% to 90%, and C2 from 77.4% to 85.7%), minimum acceptable diet (MAD) (C1 from 14.8% to 25.8%, and C2 7.7% to 18.5%), and minimum dietary diversity (MDD) (C1 from 13.8% to 26.1%, and C2 7% to 25.5%). Maternal dietary diversity did not increase as significantly, with the mean maternal dietary diversity score constant at 2.9 food groups across both time points in C1, and an increase from 2.6 to 2.9 in C2.

Significant increases in ownership of livestock were observed in line with program activities, including an increase in C1 heifer ownership from 9.8% to 29% as a results of MVHHs selling sheep and other assets and purchasing heifers. Sale of vegetables did not increase. Separation of animals from the HH increased from 35.2% to 45.1% in C1 and from 14.7% to 34.6% in C2 through promotion alone. Participation in program activities (cooking demonstration, agronomic demonstration, savings) was associated with improved outcomes. Children whose mothers had participated in cooking demonstrations were more likely to have adequate dietary diversity (C1 = 34.8% and C2 = 25.7%) than those who did not participate (C1 = 12.2% and C2 = 21.4%). More HHs in both cohorts received information on dietary diversity and received the information from more sources in the second survey. At baseline, 10.1% and 67.3% of C2 HHs had received no information or information from one source, respectively. Ten months later, only 0.6% of HHs had...
received no information, and more than 53% of participants had received information from three or more sources.

**Conclusion:** Annual surveys to determine status of key outcome indicators provide insight and actionable information for program implementation. HH participation in ENGINE activities appears to have led to improvements in CDDS, MAD, and breastfeeding indicators, despite greater food insecurity in the second survey. Participation in more components and greater exposure over time and through multiple channels increases the likelihood of improved practices. MVHHs had an increase in income from sale of animal products, but households were more likely to retain vegetables for household use.
Access of Nutrition Specific and Nutrition Sensitive Messages in Ethiopia: A Qualitative Gendered Comparison

Min-Barron, Jennifer Coates, Shibani Ghosh, John Maluccio, Beatrice Rogers

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Session 5: Dietary patterns, diets and food security

Implication of khat production and consumption practices in khat growing rural household regions of Ethiopia

Beyene Wondafrash, Jennifer Coates, Tefera Belachew

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Predictors of Intra-household food and nutrient allocation inequity in Ethiopia

Jennifer Coates, Bryan Patenaude, and Beatrice Rogers

Background and Objective: The objective of this paper is to understand the drivers of different types of inequities in household food and nutrient allocation.

Methods: Data derive from 1196 households that were randomly sampled from 10 woredas in Oromia and SNNPR. The panel was followed four times over two years, through two post-harvest and ‘lean season’ periods between 2014-2015; this analysis draws on data from the second round. The 1196 households were classified according to the degree to which they exhibited any of the following types of inequity, between: adult females v. adult males; children v. adult males; children v. all adults; and female children v. male children.

Results: Multivariate OLS regression models predicted the degree of inequity amongst these combinations of household demographic groupings in terms of energy, protein, and iron. The outcome variable, inequity, was defined as the ratio of average nutrient adequacy of the interest group (e.g. female children) to the average nutrient adequacy of the reference group (e.g. male children). Logistic regression models predicted inequity expressed in binary terms, as equaling 1 if the ratio of average nutrient adequacy of the interest group to the reference group was less than 1, which signifies any adequacy inequity.

Predictors in these models included: food security status, female empowerment status, total household education, total female education, male to female education ratio, household dependency ratio, wealth quintile, female headed household, male to female ratio, household size, food security (HFIAS) category, and male physical activity category. When comparing the intake adequacy of male and female children, to that of the reference group, adult males, the results show that, across calories, iron, and protein, total household education and protein adequacy were significant predictors of child-adult male inequity, whereby an increase in total education and protein adequacy increased inequity. Total female education, male to female education ratio, and dependency ratio were all significant at the .05 level; greater levels of these factors were associated with decreases in inequity.

Findings for the comparisons of inequity between children and adults showed roughly a similar pattern. The ratio of female child adequacy to male child adequacy was significantly associated with male to female ratio and female headedness, where increases in these variables were associated with greater inequity. Greater household size was associated with a more equitable distribution of nutrients relative to need. Adult female adequacy relative to that of adult males was predicted by protein adequacy, total household education, dependency ratio, and male to female ratio (increases in all of these variables were associated with significant increases in inequity, while total female education was, as in the other models, a significant positive predictor of decreased inequity).

Conclusions: The results of these analyses deepen our understanding of intra-household food and nutrient allocation in Ethiopia. Qualitative work is warranted to further explain the mechanisms behind these results. Meanwhile, programs and policies would do well to consider the intra-household effect of household food transfers, and strive to influence cultural norms and alleviate resource barriers in order to achieve greater food security for all nutritionally vulnerable household members.
Predictors of ‘diet diversity smoothing’ during the lean season in Ethiopia

Jennifer Coates, Kate Spielman, Dianna Bartone, Katie Heneveld, Michelle Borges, Natalie Theys and Meghan Kershaw

Background: This study sought to understand: 1) the extent to which households in two regions of Ethiopia manage to smooth their dietary diversity across seasons; and 2) the household-level factors that are associated with successful smoothing.

Methods: The analysis draws data from a panel of 1,200 randomly sampled households in Oromia and SNNPR that were surveyed four times -- during two ‘post-harvest’ and two ‘lean season’ periods -- between 2014 and 2015. After exclusions for missing data, a total of 1,007 households were included in the analysis. Successful dietary diversity smoothing was defined by 1) maintaining or improving a dietary diversity score to at least 5 food groups across the post-harvest and lean seasons, and 2) consumption of nutrient-dense foods (fruits, vegetables, and/or animal source products) across multiple seasons.

Results and Conclusions: The study hypothesizes that greater production diversity, greater nutrition knowledge, empowered women, market access, and greater levels of participation in ENGINE nutrition-sensitive activities will be associated with smoother dietary diversity across seasons. Although no clear population-level seasonal trends in dietary diversity emerge, preliminary results suggest that households with a younger household head, greater per capita wealth, and empowered women were more successful dietary diversity smoothers (defined as maintaining a score at or above 5, compared to the reference category of starting with but not maintaining a dietary diversity score at or above 5).

Furthermore, when controlling for baseline diet diversity score, households with a male household head, greater per capita wealth, empowered women, and who did not fast the previous day consumed significantly more nutrient dense foods during the lean season. Overall, consumption of nutritious foods such as meat, fish, eggs, and fruit remains low during all seasons, while consumption of legumes appears to drop during the lean season. These results are expected to inform food-based approaches to protecting the diet quality aspect of household food security.
Session 6: Nutrition Policy Research in Ethiopia

Multisector Nutrition Program Governance and Implementation in Ethiopia: Opportunities and Challenges

Eileen Kennedy, Masresha Tessema, Tesfaye Hailu, Dilnesaw Zerfu, Adamu Belay, Girmay Ayana, Desalegn Kuche, Tibebu Moges, Tsehai Assefa, Aregash Samuel, Tarik Kassaye, Habtamu Fekadu, and Joan Van Wassenhove

Background: Governments globally are stressing both direct nutrition interventions combined with nutrition sensitive policies and programs to combat malnutrition. Governance at all levels has been identified as a critical element in ensuring success of national nutrition plans. For example, the most recent National Nutrition Program (NNP) in Ethiopia discusses the essentiality of governance and coordination at all levels.

Methods: The research uses a qualitative study based on semi-structured interviews with key informants. The research discussed in this article focuses on governance structures from national to regional to district level in Ethiopia with an emphasis on translation of a strategy and implementation of the NNP. This article concentrates primarily on results from the national and regional levels.

Results: Data at both the national and regional levels indicate that there is general agreement on the nature of the nutrition problems in Ethiopia. At all levels of government, under nutrition, food insecurity, and micronutrient deficiencies were listed as the main nutrition problems.

Conclusions: The challenges in governance and implementation identified at both the national and regional levels, however, varied. The implementation of the 2013 NNP was in its early stages at the time of this research. While there was palpable energy around the launch of the NNP, respondents indicated issues related to leadership, coordination, collaboration, advocacy, and budget would be challenges in sustaining momentum.

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Background: Health and vitality of human beings depends on diets with adequate amounts of vitamins and minerals. The adverse effects of micronutrient deficiencies are most severe on children, pregnant women and the developing fetus. Approximately 30% of the world’s population is unable to use their full mental and physical potential as a result of micronutrient malnutrition. In Ethiopia vitamin A, Vitamin B12, Iodine, Iron, and Zinc are public health important.

Objective: The objective of this study was to estimate the prevalence of anemia, iron deficiency, vitamin A deficiency, zinc deficiency, iodine deficiency and adequately iodized salt access in Ethiopia.

Methods: Cross sectional study with a representative sample of nine regions and two city administrations of the country was conducted from March to July 2015. Information related to household (HH) characteristics, socio-economic and demographic were collected. In Ethiopia the prevalence of inflammation as measured by CRP and AGP among under five children, school age children and non pregnant women of reproductive age were 44%, 31.6% and 27.3% respectively.

Results: The prevalence of anemia adjusted for altitude among preschool children, school age and non pregnant women of reproductive age were 34.6, 25.6 and 17.8%, respectively, and the deficiency was higher among rural residents. Iron deficiency among preschool children, school age children and women of reproductive age as measured by ferritin and adjusted for inflammation was 17.8, 9.1 and 10.0% respectively. Whereas national prevalence of iron deficiency among preschool children, school children and women of reproductive age as measured by STFR was estimated 29.6%, 19.5% and 16.4% respectively. Therefore, the deficiency of tissue iron and depleted body iron stores is more prevalent among preschool children than the other target groups. Nationally vitamin A deficiency was 14%, 10.9% and 3.4% in the preschool children, school children and women of reproductive age respectively. The national vitamin A supplementation coverage in the preschool age children was 63%. Among the survey population of zinc deficiency was 35, 36 and 34% in the preschool children, school age children and women of reproductive age respectively. Prevalence of iodine deficiency in school age children and women of reproductive age whose mean urinary iodine concentration below the cut-off were 48% and 52% respectively. Only about 26% of the households were getting adequately iodized salt.

Conclusions: Based on the current survey findings, Zinc, Vitamin A, B12 and Iodine are public health problem. Since the magnitude of the deficiencies of these micronutrients are widely varied among different target groups targeted intervention required to address the deficiencies.
Poster Presentations

Comparability of LNMP and Ultrasound in estimating gestational age during early pregnancy

Abdulhalik Workicho, Tefera Belachew, Roos Verstraeten, Meghan Kershaw and Patrick Kolsteren

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Determinants of multiple anthropometric deficits in southwest rural Ethiopia: Conventional verses composite anthropometric index

Netsanet Fentahun, Tefera Belachew and Carl Lachat

Background: Despite some positive developments, undernutrition is still a global concern in low-income and middle-income countries. The reasons were lack of an integrated approach to understand and address undernutrition. The composite index brings more precision to the identification of the more nutritionally vulnerable segment of the population. The composite index of anthropometric failure is the summation of stunted only; wasted only; underweight only; stunted and underweight; wasted and underweight and stunted, wasted, and underweight.

Objective: To determine undernutrition and their determinants according to a composite index of anthropometrical failures and conventional indices

Methods: We used data generated from three rounds longitudinal panel survey conducted in nine districts in Oromia and Southern Nations, Nationality and Peoples Regions of Ethiopia from Feb 09-April 09/2014, Sept 22-Nov19 /2014 and March 04-May 01/2015 respectively. We estimated undernutrition using conventional indices and composite index of anthropometrical failures. Five hundred seventy nine, 674 and 674 children under age of five were included in round one, two and three in the analysis. The households were recruited using the expanded program on immunization sampling method. The hierarchical nature of the data was taken into account during the statistical analysis using a two level mixed-effects logistic regression model.

Results: A composite anthropometric index estimated 45.1%, 42.4% and 46.4% undernourished at round one, two and three respectively. The conventional indices estimated 24.4%, 24.2% and 30.4% underweight at round one, two and three respectively. Multiple anthropometrical failures, stunting, and wasting had almost similar determinant factors. Being female (OR= 7.41; 95%CI (3.90, 14.04); low dietary diversity (OR= 3.11; 95%CI (1.63, 5.90); medium dietary diversity (OR=1.93; 95%CI (1.13, 3.30) and no special foods during illness (OR=1.82; 95%CI (1.20, 2.76) were determinant of multiple anthropometrical failures.

Conclusion and Recommendations: The conventional indices under estimated the prevalence of undernutrition by 20.7%. The shared determinants of multiple anthropometrical failures, stunting and wasting were the age of the child, being female and the reporting that the child did not feed special foods during illness. Child should benefit from nutrition intervention to reduce undernutrition.
Validation of the Patient Health Questionnaire (PHQ-9) as a Screening Tool for Depression in Pregnant Women: Afaan Oromo Version

Yitbarke Kidane Woldetensay, Tefera Belachew, Markos Tesfaye, Eva Johanna Kantelhardt and Veronika Scherbaum

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Appendix 1: Previously Conducted Research

Abstracts of previously conducted research are appended below.

Factors associated with stunting in Ethiopian children under five

Shibani Ghosh, Devika Suri, Desta Hiko, Netsanet Fentahun and Jeffrey K. Griffiths

Background: Ethiopia suffers high rates of both infant mortality (52 per 1000) and malnutrition in infants and young children, contributing to an estimated 270,000 deaths per year, or one-third of all deaths in under-five children. This study aimed to examine risk factors for stunting in Ethiopian children using DHS data from 2011, and to examine the trends, variability, and changes in these factors over time using the 2000 and 2005 DHS.

Methods: Data were obtained for the latest Demographic and Health Survey (2011) as well as for the years 2000 and 2005. The sample size was 11,636 (DHS 2011), 9845 (DHS 2005) and 10,873 (DHS 2000) children under five years of age. The analyses used a conceptual framework that categorizes factors affecting height for age in infants and young children as being inherent, distal, intermediate and proximate in nature. Descriptive statistics (including means, standard deviations, frequencies, Pearson correlations, and odds ratios were estimated. Step-wise multivariate linear and logistic regressions were then conducted. The analyses focused on identifying statistically significant associations with stunting outcomes in individual children. A subset of analyses examined the associations between specific foods, and of sanitation, with stunting by region.

Results: In infants <6 months of age, stunting rates have significantly decreased, going from 22% (2000) and 23% (2005) to 14% in 2011. Stunting rates for children aged 6-24 months went from 49% in 2000, to 47% in 2005, to 35% in 2011. For children under five, rates similarly declined significantly from 54% in 2000, to 49% in 2005, and to 41% in 2011. In 2011, stunting rates are as high as 40% in Afar, Amhara, Tigray, and Benishangul-Gumuz, with the highest rates in Tigray (52%). Rates in Oromiya, SNNPR, Dire Dawa, Gambela, Harar and Somali region range from 21-32% while Addis Ababa had the lowest rate (13%).

Infants and young children were 2.2 times more likely to be stunted if born to mothers in the poorest households than richest households. Infants and children with a very small reported birth size were twice as likely to be stunted as those very large at birth. Girls were 25% less likely to be stunted than boys. Risk factors associated with stunting differed by age group. Maternal height was a significant predictor of the risk of being stunted in infants less than 6 months of age. For children aged 6-12 months, increasing age, male sex (gender), and short maternal height were significant predictors as well as low birth weight. Predictive factors for the age group 12-24 months included age, being a boy, wealth index, maternal education (p > 0.05), birth size, maternal height and still being breastfed. In children greater than 24 months of age, stunting was also associated with shorter birth interval, lower maternal BMI, having had a diarrheal episode and having had a fever within two weeks prior to the survey.

Analyses were also conducted to examine variation in dietary pattern by region and risk of being stunted. Dairy and the consumption of ‘other’ (non-green leafy, vitamin A rich) fruits and vegetables were both protective against stunting (OR=0.72 and 0.47, respectively). Consumption of grains roots and/or tubers, or legumes, was positively associated with stunting (OR=1.52 and 1.35, respectively). Regions with higher mean dairy consumption were more likely
to have less stunting. The consumption of dairy alone explained ~27% of the stunting variation between regions ($R^2 = 0.2672$). Stunted children were likely to have been reported as consuming more meat but the association was not significant.

Regional analyses were also conducted to examine open defecation and the risk of being stunted. Open defecation explained 29% ($R^2 = 0.29$) of the variation in stunting by region. In a multivariate model, which started with open defecation and then included factors in a stepwise fashion, the addition of first of wealth index and then of maternal height markedly increased the explanatory power to 71% of the variation at the regional level ($R^2 = 0.71$). However, this statistically reduced the individual predictive significance of having a latrine ($p>0.05$).

**Conclusions:** Factors associated with stunting (DHS 2011) include the child’s age, male gender, household wealth, maternal education, birth interval, birth size, maternal height, maternal BMI and having had diarrhea in the past 2 weeks. Comparing trends, across years, shows several common risk factors associated with stunting. Common predictors of stunting for all 3 survey years included age, male gender, lower birth interval, lower birth size and maternal height, while the factors associated with stunting that were unique to 2011 included maternal BMI, and if food was given in the first 3 days of life and low wealth index. Regional level analyses show that dietary patterns of children 6-24 months are associated with risk of being stunted, as is the presence of open defecation.
Trend, Variability and Determinants of Wasting and Underweight in Ethiopian under five children: Ethiopian Demographic and Health Survey, 2000-2011.

Desta Hiko, Shibani Ghosh, Devika Suri, Jeffrey K. Griffiths, Netsanet Fentahun

**Background:** Ethiopia is known for a long history of food short-falls and famine emergencies that was attributable to high levels of severe acute malnutrition. Adequate nutrition is a basic human right and a pre-requisite for good health. Severe and repeated attacks of malnutrition during childhood can negatively impact the physical and mental development of children. Many nutritional studies have demonstrated that malnutrition in Ethiopia is serious. It is estimated that malnutrition contributes to an estimated 270,000 deaths of under-five children each year.

**Objective:** To assess trend, variability and determinant of wasting and underweight in Ethiopian under five children: Ethiopian Demographic and Health Survey, 2000-2011

**Methods:** Stratified and two stage clustered Demographic and Health Surveys were conducted in all nationally representative population within study periods of the three Ethiopian Demographic and Health Survey among sampled under five children. This study will use data of 2000, 2005 and 2011 for trend and variability analysis. Extraction of variables was done to identify the variables that fit to analysis. After extraction, Data was weighted as per Ethiopian Demographic and Health Survey weights and explored to observe the nature of data and distribution variables paramount important for analysis. Data of three Ethiopian Demographic and Health Survey were merged and imported to Antro-plus to determine the nutritional status of the children under age of five. Logistic regression was conducted to identify the independent determinants of wasting and underweight. The descriptive finding was presented using graphs.

**Results:** The prevalence of wasting was 12%, 10.8% and 11.4% in 2000, 2005 and 2011 among children under age of five in Ethiopia. The prevalence of wasting in male and female children was 12.7%, 12.1% in 2000 respectively. The prevalence of wasting among male and female children was 12.1%, 10.7% in 2011 respectively. The prevalence of underweight was 39.8%, 33.2%% and 30.5% of children under of age in the 2000, 2005 and 2011 years respectively in Ethiopia. The prevalence of underweight was 40.8%, 34.7% and 32.5% among male children in the year 2000, 2005 and 2011 respectively in Ethiopia.

Children who delivered at home were 1.55 times more likely wasted than children who delivered at health institution (AOR, 95%CI 1.55 (1.04, 2.32). Children of mothers whose ages were between 40-45 years were 1.60 times more likely to be wasted than children whose mothers’ ages were between 25-29 years (AOR, 95%CI 1.60(1.14, 2.23). Male Children were 1.39 times more likely wasted than Female Children (AOR, 95%CI 1.39(1.18, 1.64).

Mothers whose ages were between 20-24 years were 21% times less likely to have an underweight child than mothers whose ages were between 25-29 years (AOR, 95%CI 0.79 (0.64, 0.98). Mothers whose ages were between 35-39 years were 32% times less likely to have underweight child than mothers whose ages were between 25-29 years (AOR, 95%CI 0.68 (0.56, 0.84). Male children were 1.51 times more likely underweight than female children (AOR, 95%CI 1.51 (1.33, 1.73). Mothers whose children birth interval were less than 24 months were 1.44 times more likely to have underweighted child than mothers whose children birth interval were greater than 48 months (AOR, 95%CI 1.44 (1.16, 1.79).
Conclusion: The trend of wasting was not constantly decreasing from 2000-2011. The trend of Underweight was constantly decreasing from 2000-2011. Region, wealth index, sex of the child, size of child at birth, place of delivery, age of mother and age of child are determinant of wasting for children under age of five in Ethiopia. Wealth index, sex child, size of child at birth, age of mother, age of child, dietary diversity and birth interval are determinant of underweight for children under age of five in Ethiopia. Therefore, every stakeholder should promote nutritional intervention considering the main determinant of wasting and underweight to reduce the prevalence of wasting and underweight among children under age of five in Ethiopia.
Production Diversity, Agricultural Commercialization, Women’s Empowerment, and Dietary Diversity

Jennifer Coates and Tina Galante

Development policy is once again trending in favor of support to smallholder farmers as a key driver of poverty reduction and food security in developing countries. In parallel to renewed investments in agriculture, the international nutrition community has sought to take advantage of ‘indirect’, ‘nutrition sensitive’ approaches to advancing nutrition objectives, through pathways that stimulate the production and income of smallholders. Among the many entry points rediscovered by nutrition practitioners, three in particular are viewed as potentially promising micro-level mechanisms for improving the nutritional status of smallholder household members through enhanced diet quality: diversifying production to include nutritious fruits, vegetables and animal products, boosting smallholder commercialization to generate income to purchase a healthier diet, and empowering women in agriculture to direct production and income gains toward better nutrition for themselves and their families.

Yet, uncertainty persists over whether, and under what circumstances, such interventions are likely to be effective in improving diet quality. Moreover, the question of which of these three pathways is likely to lead to greater diet quality has yet to be examined comparatively in the same data set. The current study seeks to bolster this evidence base by addressing the following questions: Among Ethiopian smallholder farm households, what is the relative extent to which household dietary diversity and the consumption of specific food groups are explained by production diversification, commercialization, and women’s empowerment? Furthermore, because greater female control over resources may affect both production-consumption and income-consumption pathways, to what extent does women’s empowerment attenuate or amplify relationships between production diversity, commercialization, and dietary diversity? The answer to these questions is significant as these three pathways suggest very different policy directions to achieving dietary improvements for smallholder agricultural households.

The data for this study were derived from the 2012 Living Standards Measurement Study-Integrated Surveys on Agriculture: Ethiopia Rural Socioeconomic Survey (LSMS-ISA: ERSS), implemented by the Ethiopian Central Statistics Agency (CSA) with technical support from the World Bank. Using a two-stage probability sampling method, 3,996 households were interviewed from 290 rural and 43 small town CSA enumeration areas, covering all 9 regions of the country.

The relationship between food production diversity and household dietary diversity was small and non-significant, while engaging in cash crop production was associated with the consumption of 0.3 more food groups \( (p < 0.01) \). For male-headed households, the results show that each 1,000 Birr of additional agricultural income was associated with a 0.04 food group increase in HDDS \( (p < 0.01) \). The coefficient on the interaction of female household headship with total agricultural income was significantly positive, at 0.07, meaning agricultural commercialization had a larger effect on household dietary diversity for female-headed households \( (p < 0.01) \). Market access was also found to be a significant but relatively weak predictor of dietary diversity, with longer distances predicting lower HDDS \( (p < 0.01) \). Female sole or joint ownership of at least one large asset was associated with an increase of 0.6 in HDDS \( (p < 0.001) \). Similarly, female literacy was associated with a 0.4 HDDS increase \( (p < 0.01) \). In fact, female asset ownership and literacy were much more strongly and significantly associated with dietary diversity than were agricultural income or production diversity.
In addition to examining the role of production diversity, commercialization, and female empowerment in dietary diversity, this study also analyzed the relationship of these factors to the consumption of specific food groups. Logistic regression models showed that the production of a given non-cereal food group in the past year was positively associated with consumption of that same food group. Specifically, households that reported producing pulses, roots, and eggs were nearly twice as likely to have consumed those food groups, while households producing fruit and dairy were 2.7 and 3.9 times as likely to consume those respective foods (all significant at p<0.001).

Households that were more highly commercialized were more likely to consume nutrient dense foods. Controlling for wealth, households in the highest quartile of agricultural income were 2.5 times as likely to have consumed vegetables (p<0.001), 2.1 times as likely to have consumed dairy (p<0.01), and 1.9 times as likely to have consumed oil/fats (p<0.05) as households in the lowest quartile, all else equal.

Female asset ownership was associated with a significantly higher probability of the consumption of roots, vegetables, oils/fats, sugar/honey, and meat (all significant at p<0.05 or less), whereas female literacy was only found to be significantly associated with a 48% increase in pulse consumption (p<0.05). Having a female head of household was only a significant predictor in two models; female-headed households were half as likely to consume sugar/honey and meat compared to male-headed households (p<0.05).

The results of these analyses suggest that policies to increase smallholder agricultural commercialization can benefit household diet quality through the agricultural income pathway. Additionally, programs and policies that aim to increase smallholder production of nutrient-rich foods can lead to increased consumption of these foods, regardless of income from agricultural sales. Finally, agriculture programs that empower women and enable them to have greater control over assets and other decision-making will likely see improved dietary diversity, both as part of, and independently of, commercialization efforts.

Abdulhalik Workicho, Tefera Belachew, Garumma Tolu Feyissa, Beyene Wondafrash, Carl Lachat, Roosmarijn Verstraeten, Patrick Kolsteren

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Determinants of Participation in the “Nutrition-sensitive” Agricultural Activities of a Large-scale Integrated Nutrition Program in Ethiopia

Jennifer Coates and Yohannes Tesema

Programmatic targeting, an intentional strategy to both attract and limit beneficiaries to those that meet specific eligibility characteristics, is just one aspect of reaching desired households (or individuals) with a given intervention. Households must not only be eligible to participate, they must also demand the services on offer and have physical and economic access to them in order to benefit. Yet, there is very little information on what conditions contribute to households’ participation in nutrition-sensitive agricultural interventions in developing countries.

The current study aims to understand 1) the rate of household participation in different types of “nutrition sensitive” activities, and 2) the determinants of household participation in these nutrition sensitive interventions. The data for this study were derived from the first round of a four round longitudinal panel survey of 1196 rural households in the Oromiya and SNNPR regions of Ethiopia. Nutrition sensitive activities in the 10 sampled woredas included: agronomic demonstrations to promote production diversity held at farmer training centers and at schools, cooking demonstrations to promote the preparation of meals with a diversity of ingredients, the distribution of seeds, tools and fertilizer (to “most vulnerable households”), and extension support by development agents (DA’s) related to improving the production of horticultural products and small livestock.

A participation index was created representing the number of different activities in which a household had participated in the previous 6 months. Multivariate Poisson regression model predicted the level of participation from nineteen hypothesized explanatory variables. The model was adjusted for over-dispersion and sampling weights were applied to obtain robust standard errors.

Wealth, food security status, child dependency ratio, land cultivation, and participation in other social programs were found to be significantly and positively associated with greater rates of participation. Households headed by females had significantly lower participation rates than households headed by males. An unexpected result was that the distance to health clinics and veterinary clinics was significantly associated with participation rates in a positive direction; households that were farther away had higher participation rates than households that were closer to this infrastructure, while distance to farmer training centers and the DA office had no bearing on participation rates.

Taken collectively, the findings suggest that not all households situated in agriculturally productive areas targeted by the Agriculture Growth Program (AGP) and ENGINE access nutrition-sensitive agricultural services. Households with less wealth, less land, less labor, and fewer social connections are either not opting or able to benefit from nutrition-sensitive agricultural interventions. Though nutrition-sensitive agriculture interventions don’t lend themselves to individual-level targeting the way that nutrition programs do, such programs should reconsider strategies for generating demand and outreach around activities such as farmer demonstrations and extension to take into account opportunity costs and other barriers to participation so that relatively disadvantaged households may equitably benefit. ENGINE has sought to address this challenge squarely by directly targeting the most vulnerable households in a community with direct support in the form of livestock, seeds, tools, and other inputs.
Predictors of participation in nutrition-specific activities of a country-level nutrition program in Ethiopia

Dianna Bartone, Kristine Caiafa, Ashley Wickland, Robert Houser, Jennifer Coates

Little is known about the predictors of participation in nutrition-specific activities implemented at scale. This analysis examines the relationships between household- and caretaker-level characteristics and participation in nutrition-specific components of a multi-sector program in Ethiopia called Empowering New Generations to Improve Nutrition and Economic opportunities (ENGINE).

The data derive from a survey of 1200 randomly selected households in Oromia and SNNPR implemented after three years of nutrition-specific ENGINE programming. Among these households, 593 had a child under five years of age with a mother or other caretaker who responded to questions about participation in nutrition-specific activities.

Multinomial logistic regression analysis was used to determine relationships between household- and caretaker-level characteristics and degree of participation in nutrition-specific activities based on a participation index constructed from equally weighted affirmative responses to participation in the following activities: 1) visiting a health facility to receive nutrition assessment counseling and support (NACS); 2) participating in community conversation sessions; 3) attending a women’s support group to learn about nutrition/personal hygiene; and 4) attending a cooking demonstration.

The analysis found that participation in nutrition-specific activities was low overall and varied by caretaker and household characteristics. Just slightly more than half (54%) of households reported participating in any nutrition-specific activities. Households with higher social capital were more likely to participate in any activity, whereas households with a disabled caretaker were less likely to do so.
Filling a dietary data gap? Validating the Adult Male Equivalent method of estimating individual nutrient intakes from household-level data in Ethiopia and Bangladesh

Jennifer Coates, Beatrice Lorge Rogers, Alexander Blau, Jacqueline Lauer

Dietary intake data are needed for many food policy purposes but are not consistently collected in many low-income countries. Many countries conduct Household Consumption and Expenditure Surveys (HCES), and efforts have been made to use these data to estimate individual intakes, often based on the assumption that food is allocated within households according to the proportional energy requirements of members relative to an adult male (called an adult male equivalent, or AME). This study sought to validate the AME-based estimates of individual consumption of calories, protein, animal source protein (ASP), and iron from household data using data sets from Bangladesh and Ethiopia that measured both household consumption and individual intakes across ten age-sex groups. The study also compared the accuracy of using AMEs based on energy with AMEs based on the relevant nutrient (protein, iron) and assessed the effect of adjusting the data for meal partakers.

Energy-based AME predictions resulted in more accurate intake estimates than the nutrient-specific AME predictions. AME-based predictions of nutrient intake were accurate within ten percentage points of individually reported intakes in most cases, but were inaccurate among infants 6-23 mo and (for some nutrients) children in Bangladesh, and were less accurate in predicting ASP than other nutrients.

The degree of accuracy of the AME-based method was greater across all nutrients in the Ethiopia sample, suggesting that intra-household allocation of these nutrients in Ethiopia was generally more equitable than in Bangladesh, when defining ‘equitable’ according to relatively energy requirements. However, when using the nutrient-specific AMEs, the Ethiopian results uncovered inequitable intra-household allocation of iron, protein, and animal source protein relative to iron and protein requirements. For instance, children and youth consumed relatively more than their ‘fair share’ of household protein while adults and the elderly consumed relatively less. With iron, the opposite was true: adult males and male and female elderly consumed slightly more than their ‘fair share’, while children and adult females consumed slightly less.

AME predictions were less accurate in correctly classifying population subgroups as adequate or inadequate, with errors of exclusion and inclusion exceeding acceptable levels for several subgroups and nutrients. Use of the energy AME can produce useful results for estimating average consumption by subgroup, but should be complemented with data on individual intakes for identification of groups at risk of inadequate consumption.
Appendix 2: Methodologies for the Agriculture Nutrition Panel Study and the Birth Cohort Study

Agriculture and Nutrition Panel Study: Evaluating Multisectoral Strategies for Improved Nutrition and Food Security in Ethiopia: A Panel Study

Dr. Jennifer Coates (PI, Tufts University)
Dr. Beyene Wondafrash (Co-PI, Jimma University)
Mr. Alemzewed Roba (Co-PI, Hawassa University)

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Study Rationale: Although Ethiopia has been one of the few countries that has made significant progress towards the Millennium Development goals, a large portion of the population continues to suffer from malnutrition, even in areas considered to be relatively food secure. With the majority of the country engaging in smallholder farming, policy makers and nutrition experts alike have begun to reconsider the role of agriculture as a potential pathway to improved nutrition. Though the ENGINE program is being implemented through both the government health, agriculture, and education sectors and support multi-sectoral approach at different level including woredas, there is very limited evidence regarding the effectiveness of multi-sectoral approaches and delivery strategies in Ethiopia, and how these approaches can most effectively be combined to reduce household food security and malnutrition.

This “Agriculture-Nutrition Panel Study” will provide the opportunity to rigorously research how and why specific strategies and approaches (including co-location of multi-sectoral interventions) address food security and nutrition concerns of women and children in smallholder farming households, a key target population of the Government of Ethiopia and the USAID Feed the Future Initiative. This study will examine ENGINE’s role in affecting nutrition, food security, and livelihoods outcomes through its integrated programming and answer key questions about participation in nutrition sensitive and nutrition specific interventions, and household decision making around achieving micronutrient balance, household food and nutrient allocation equity and seasonal diet smoothing among others.

Study Design: The study follows a sample of 1200 smallholder agricultural households randomly selected from Nutrition Sensitive and Nutrition Specific kebeles in 10 woredas in Oromiya and SNNPR where both the ENGINE and Agricultural Growth Program (AGP) are active. These households were followed over a period of two years, and surveyed twice per year in the post-harvest and ‘lean’ seasons. A quantitative survey collected information on household economic well-being, agricultural practices, homestead gardening, livestock ownership, household dietary intake, food security, child feeding practices, child health, program exposure and participation, female empowerment, social networks, and nutrition knowledge. The study was conducted collaboratively with Jimma University, Hawassa University, and EHNRI in order to strengthen their institutional capacity to carry out these types of investigations, and also
supported two ENGINE PhD candidates in collecting their dissertation research. Data collection of the four rounds was completed on October 29, 2015.

**Study Purpose:** These results will inform how best to link agricultural and nutritional interventions so that optimal nutritional outcomes may be reached. By elucidating household behaviour with regard to nutrition-sensitive agricultural interventions, these results will also provide essential information about the best ways to sustainably improve the delivery and uptake of nutritionally-enhanced agricultural practices.

**Study Importance:** A key mandate of ENGINE is to strengthen nutrition through the health sector while also working with Agriculture sector to implement nutrition sensitive agriculture and integrate NSA with existing governmental agricultural initiatives, such as the Agricultural Growth Program. Without a solid understanding of the individual and household dynamics that exist with regard to these multi-sectoral interventions, neither objective can be successfully achieved. As Ethiopia takes strides toward integrating nutrition-related considerations into its agriculture policy and programs, this study will help promote urgently needed evidence-based recommendations to enhance the success of the outcome of multi-sectoral programing.
Birth Cohort Study: Effectiveness of Direct and Indirect Interventions Targeting Maternal and Child Nutrition and Health Outcomes: A Quasi-Experimental Observational Birth Cohort Study

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Study Rationale: The new Accelerated Stunting Reduction Initiative highlights the importance of early action to address stunting in Ethiopia. Stunting begins in many cases early on in life, even before birth. Thus strategies to address this public health issue require consideration of pregnancy and gestation through 2 years of age of an infant. Factors affecting stunting can range from maternal health and nutrition to poor socio-economic status, to poor access to good quality foods and poor hygiene, water and sanitation. Anemia is also a significant contributor to morbidities in mothers and children in Ethiopia. This can be compounded by poor diets or malaria, especially in pregnant women. However, only limited evidence exists on what is the most effective set of approaches and delivery strategies in Ethiopia, and how these approaches work in addressing stunting and anemia. A prospective observational birth cohort study provides an opportunity to rigorously understand how and why specific strategies and approaches address nutrition and health concerns of vulnerable groups, namely, pregnant women and infants, key targets for the Government of Ethiopia and the US Government Feed the Future Initiative. The following series of abstracts helps set the stage in understanding the underlying maternal and infant nutrition relationships. Subsequent to this, analyses conducted will allow us to examine if and how any strategies in place address their nutrition and health concerns.

The study was conducted collaboratively with Jimma University, Hawassa University, and EHNRI in order to strengthen their institutional capacity to carry out these types of investigations, and also supported four ENGINE PhD candidates in collecting their dissertation research.

Study Design: A sample of 4,680 pregnant women were enrolled and followed through childbirth until their child reached one year of age. Women were enrolled from three woredas in Oromia region, two ENGINE woredas and one non-ENGINE woreda. The mother-child dyads were visited every 3 months after birth. Information was collected on: antenatal care; pregnancy outcomes such as birth weight; maternal and child nutrition over time (anthropometry); breast feeding and food consumption; diet diversity; food security; livelihoods, agricultural productivity and market participation; household socioeconomic status; education; water/sanitation/hygiene; and hemoglobin, blood pressure and malaria testing. In addition, exposure and uptake of
program interventions such as ENGINE and AGP were collected. The Birth Cohort Study also contained a Frontline Worker component, composed of interviews with Health Workers, Health Extension Workers, and Agricultural Extension Agents to understand their knowledge, attitudes, and practices regarding nutrition, health, and motivation for service provision. Data collection was completed at the end of March 2016.

**Study Purpose:** This study will hone in on the integrated effects of improved livelihoods, direct nutrition interventions and WASH on maternal and child health and nutritional status and answer other important questions related to improving maternal and infant health and nutrition outcomes.

**Study Importance:** The results will help to advocate for the most effective combination of approaches and delivery strategies in Ethiopia to improve maternal and child nutrition and health including the prevention of stunting and anemia in infants and children.