One size does not fit all: stunting and social protection in rural Tanzania?

Wei Ha

UNICEF Tanzania[1]

6 September 2013

1. Background

Malnutrition in Tanzania

Nutrition has featured prominently in Tanzania's quest for prosperity and development. Malnutrition was identified as one of the big three enemies of the people alongside poverty and ignorance in the 1967 Arusha Declaration which set out the vision and direction for Tanzania's development in the following two decades. The Iringa Nutrition Project initiated by Tanzania Food and Nutrition Council (TFNC) under WHO/UNICEF support between 1979and 1992 not only reduced prevalence of underweight from 56% to 38% in five years (TFNC, 2004) but also facilitated the development of the UNICEF conceptual framework of malnutrition and greatly influenced the global thinking on how to improve nutritional wellbeing in developing countries.

However, consolidating the earlier gains in tackling malnutrition (primarily underweight) has proved to be much more challenging. Government was preoccupied by the economic restructuring and liberalization since the early 1990s and diverted attention and resources from community based activities (Jonsson, 2003). As a result, the situation of malnutrition in Tanzania has improved but remained serious between 1992 and 2010. Stunting among under-5 children has reduced from 50 per cent to 43 per cent while underweight among under-5 has declined from 25 per cent to 16 per cent (WHO, 2011).[2] Given the rapid population growth, there are more chronically malnourished children in Tanzania today than have ever been recorded before. Between 2005 and 2010, the number of stunted children rose by about 300,000 to over 3 million.

[1] The author acknowledges the comments from various UNICEF colleagues at the meeting of Strategic Moments of Reflections on Nutrition in March 2012 held in UNICEF Tanzania.

[2] Stunting is defined as having height-for-age below 2 standard deviation of the WHO 2006 reference group

This burden of stunting is higher than any other Africa countries with the exception of Ethiopia and the Democratic Republic of Congo.

Riding on revived interest in nutrition by the global development community,[3] the country's top leadership has made several important commitments towards improving nutrition recently. A high level meeting on nutrition was convened in June 2011 by the Prime Minister together with the US Secretary of State and Deputy Prime Minister and Minister of Foreign Affairs and Trade of Ireland where the Prime Minister of Tanzania "fully endorses and supports" the Scaling Up Nutrition (SUN) movement.[4] The National Nutrition Strategy (NNS) was launched by the Prime Minister in September 2011 and the Implementation Plan of the National Nutrition Strategy (2011/12 to 2015/16) was endorsed by the government with a budget of US$ 528 million. On 16th May 2013, President Kikwete launched a National Call for Action to scale up nutrition in Tanzania where he stressed the importance of nutrition advocacy at all levels of government and urged the stakeholders from the public sector to secure adequate budget for addressing nutrition within their respective sectors – from national to local/district levels.

Social Protection and Nutrition in Tanzania

Since the 1970s, malnutrition has been understood as a multisectoral problem and requires multisectoral interventions (Garrett and Natalicchio, 2011). The UNICEF conceptual framework on nutrition provided the best summary of this development. Since the late 1990s, social protection agenda has been gaining momentum in the development discourse spearheaded by the conditional cash transfer programmes originated in the Latin America. Broadly speaking,

[3] "Offi cial development assistance to the basic nutrition category has increased from US$259 million in 2008, to $418 million in 2011—a rise of more than 60% (although it was $541 million in 2009).1 Furthermore, the G8 countries reported increases of almost 50% in bilateral spending on nutrition-specifi c and nutritionsensitive interventions between 2009 and 2011.2 According to Google Trends, "malnutrition", now matches "HIV/AIDS" in terms of internet interest, whereas 5 years ago, HIV/AIDS received twice as much interest as malnutrition." *(Gillespie et al, 2013).*

4 The SUN movement is a multi-stakeholder global effort to reduce hunger and under-nutrition and to contribute to the realization of all of the MDGs, with particular emphasis on MDG 1. The SUN road map encourages countries to better focus on nutrition within development programs as they scale up nutrition activities and identify investments that have been shown to work if implemented within the context of nutrition-focused development policies.

social protection refers "to the public actions taken in response to levels of vulnerability, risk and deprivation which are deemed socially unacceptable within a given polity or society" (FAO, 2012). More recently, social protection has been identified as a potential solution to address the immediate and underlying causes of malnutrition which have been confirmed by empirical evidences from Latin America (Leroy et al, 2009).

The 2008 Lancet Series on Maternal and Child Undernutrition cited the conditional cash transfers with nutritional education and micronutrient-fortified food supplements as an effective nutrition sensitive intervention to tackle malnutrition. The 2013 Lancet Series on Maternal and Child Nutrition has shown a deepening understanding of the social protection issues by including unconditional cash transfers, school feeding programme, and in-kind food distribution as part of the package. Tanzania is a case in point for this global trend.

Tanzania Social Action Fund (TASAF), which has been in operation since 2000 under the President's Office, is being transformed from a traditional social fund operation that mostly finances community infrastructure/rehabilitation projects, e.g. health facilities, schools and teacher dorms, etc. into a productive social safety net (PSSN) that will pay monthly cash transfers to Tanzania's poorest and most vulnerable households. Households receiving the cash transfer will also qualify for participation in seasonal public works for up to 60 days per year, if they have an adult able-bodied person willing to work in a community project in return for a wage income. The purpose of the public works component is to provide consumption smoothing to eligible poor households during the lean season when food and cash are scarce. A related aim of the seasonal public works is to help create productive assets through, e.g. small scale irrigation, watershed management, etc. that can benefit the whole community, and to add to the cash income that eligible families will receive every month so as to increase their chances of 'graduating' out of extreme poverty.

The basic features of PSSN are such that, depending on family composition and size, PSSN households can receive anywhere from $60 to $200 per year. This compares with an extreme poverty line in Tanzania of nearly TSH 10,000 or US$6 per person (adult equivalent) per month (Household Budget Survey, 2007). Participation in the program, therefore, can bring

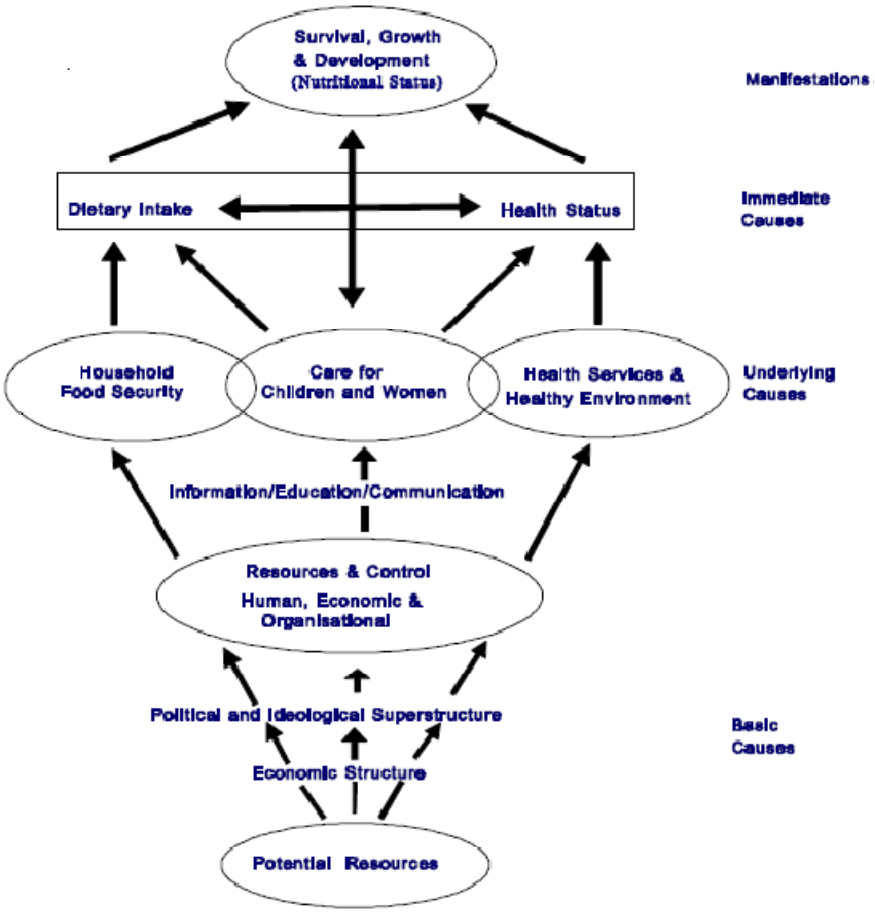
substantial extra income into a household such as to make up for a significant part of the consumption shortfall that will otherwise keep the household below the food poverty line.[5] Other non-cash linkages of PSSN with nutrition include regular checkup at health facility by under 5 children and prenatal and natal mothers; attendance at community health and nutrition sessions when such health services are not available; attendance at workshops to reinforce nutrition practices and investment in human capital.

2. Objective of the Study

The objective of this study is to provide updated empirical evidence on the associational factors of under-5 stunting guided by the UNICEF Conceptual Framework of malnutrition and inform the design of PSSN to reduce stunting in Tanzania. This framework examines the multidimensional causes of malnutrition and also the multi-sectoral nature of the problem at both macro- and micro-levels. It also classifies the causes of malnutrition at different levels including Immediate Causes (dietary intake and disease at individual level), Underlying Causes (health services, healthy environment, maternal and and child caring practices, and food insecurity at individual child and household level) and Basic Causes (socio-economic and political factors at the household and societal level). Underpinning the framework is the assumption that factors at one level influence factors within the same level and other levels. For example, a household's wealth (a basic cause) can affect its ability to access health services and food (underlying causes) which in turn determines their children's dietary intake and health status (immediate causes). To illustrate this point, UNICEF (1990) uses the formal education system as an example. Schools "play an important role as the interface between underlying and basic causes as they provide basic services but also promote improved practices regarding food production and child care (underlying causes)." In short, malnutrition and death in children and women are the results of a long sequence of interlinked events that should be analyzed holistically so that a local model can emerge.

[5] With a $220 million concessional loan from the World Bank and other funding, TASAF III seeks to roll out its package of cash transfers and seasonal wage income from public works to an estimated 250 to 275 thousand poor households within five years (2013-17), covering every district in the country. Additional funding could be made available at that point to expand the reach of the program even further. The aim is to gradually make the PSSN into the cornerstone of a permanent social safety net in Tanzania, which can help poor families weather the effects of recurrent shocks and chart pathways out of chronic poverty.

Figure X. UNICEF Conceptual Framework of Malnutrition



Source: UNICEF 1990.

3. Methodology

We employ linear probability regression models to establish the relationship between stunting status of children (binary outcome) and the various potential causes identified in the UNICEF conceptual framework. Linear probability regression model expresses the stunting status of under 5 children as a function of the five groups of predictors or variables as suggested in the conceptual framework.

$$Y_i = \beta_o + \beta_1 Food_i + \beta_2 Ill_i + \beta_3 Care_i + \beta_3 Health_i + \beta_4 Resources_i + \varepsilon_i$$

Y_i indicates the stunting status, 1 being stunted, 0 being not stunted; Food, IllNESS, Care, Health, and Resources represent variables vectors derived from UNICEF conceptual framework that will aid in predicting the chronic nutrition status of children; β_o is the intercept, and other β are the effects of each variables vectors on the likelihood of a child being stunted; i indicates individual children; ε_i is the error term.

Given that we have dichotomous dependent variables, logit regression model is also exploited to estimate the relationship between dependent variable and other predictors of stunting. However, coefficient estimates from a logit model is not easy to interpret. Therefore we also calculate the marginal effects from logit model where continuous variables are set at mean values and median are used as reference values for discrete variables.[6] However, we found these results comparable to those reported and discussed in the results section below.[7]

We also run different specifications of the linear probability model to see if the relationship is robust to adding more variables step by step following the hierarchy of the conceptual framework. We first examine the correlation between the immediate causes such as food intake, illness of children and food security (specification 1) and then add the measures of underlying causes on children's individual characteristics (specification 2); care vector (specification 3); health environment vector (specification 4) and eventually the basic causes on households' resources and control vector are included (specification 5).

4. Data: TDHS 2010 and summary statistics[8]

Tanzania Demographic and Health Survey 2010 (TDHS 2010) is the most recent in a series of nationally representative surveys of 10,300 households selected from 475 sample points throughout Tanzania. All women aged 15-49 years in these households and all men aged 15-49 years in a subsample of one-third of the households were individually interviewed. The survey collected information on fertility levels and preferences, maternal and child health and mortality,

[6] Marginal effects are calculated using command margins in Stata 11.0.
[7] Full results from the logit regression models are also available upon request from the authors.
[8] Difference between the summary statistics here and those in dhs could be due to weighting. Dhs report uses weighted averagess whereas we only use unweighted ones. There is a huge and unsettled debate on whether weight should be used for regression analysis. In addition, it is also related to the fact that the unknown/missing category of the reponses is also included in dhs report tabulation. Difference on ari, however, seems to be quite big.

nutritional status of women and children aged 0-59 months, use of health services, and prevalence of malaria and its prevention and knowledge on HIV/AIDS along with household and demographic characteristics.[9]

The analytical sample we constructed here consists of all under-5 children in rural Tanzania matched up with their maternal and household characteristics. As mentioned in the methodology section above, these variables are grouped into five categories. Variables in the **Food** category measure the security and availability of food at household and individual children level and include whether households have three meals a day, the frequency of being food insecure throughout the year. The **Ill** vector measures the status of children with three common childhood illness in the last two weeks before the day of the survey. The **Care** vector covers a much larger set of variables from maternal nutrition indicators such as children's birth weight and maternal boss mass index to whether children were delivered at home as opposed to be in medical facilities and whether a child was breastfed within 1 hour from birth and whether the salt used by the household is adequately iodised and slept under bed-nets as well as mothers' age and marital status. It also contains measure of the pull and push factors of the care of children by adults in the family such as mother's time spent on work throughout the year, number of under-5 children in the family and size of the households. Whether households have access to safe water and sanitation and whether the floor is made of materials and use charcoal as opposed to fire food and the distance to the nearest health facilities are used to proxy the **Healthiness** of children's environment. We proxy the household' control of **Resources** or entitlements of resources in the broader society with mother's education, wealth quintile of the households, whether the

[9] While the TDHS 2010 is the most suitable and latest household survey in Tanzania with the largest set of variables covering all potential causes identified in the UNICEF conceptual framework, it has several key shortcomings that limit the depth of our analysis and its interpretations. First, certain questions in the survey are only asked for the most recent birth of the women or for children in specific age groups. For example, antenatal care of women is only collected from respondents on their last delivery. Questions on women's decision making power within the households are only applied to women who are currently married or living with a man. Second, data on some indicators such as feeding practices relates to a short recall period, and may not reflect the longer term practices. Data on complementary feeding practices is only available for children aged less than 2 years and is only collected over the past 24 hours. There is no childhood disease information beyond the past two weeks. However, we need to have a child's history of illness in order to predict the effects of illness on stunting because stunting is a long-term measure of the nutrition of a child.. Third, like any other household surveys which faces a binding budget constraint, TDHS 2010 has to economize on questions outside the demographics and health field that forms the context under which household operates. Despite the shortcomings identified above, TDHS 2010 is still the most comprehensive survey on health and nutrition matters that facilitate the stunting analysis.

households own any land jointly or alone and the residence status. Last but not least, we also include some biological and demographic characteristics of individual children that are known predictors of their nutrition status such as children's age, children's sex, the birth order of a child and their mother's height for age.

For under 5 years old (see Table 1), 42% are stunted in rural Tanzania and 52% of children live in households which are able to have three meals per day. 20% of children live in household reporting **food security** problem sometimes. In the last two weeks before the survey, children experienced prevalence of common childhood **illness** such as diarrhea, fever and acute respiratory infection at 14%, 21% and 7% respectively.

Huge gaps in terms of **caring practices** for women and children exist in Tanzania. Less than half of all births are delivered in a health facility. 8% of children are reported to have been smaller than average at birth by their mothers. Yet, vitamin A supplementation and use of bednets while sleeping are found to be at reasonably high levels although less than ideal. Close to 64% of children's mothers[10] have to work seasonally or occasionally while 24% have full time job. Average household size is fairly large at 7.4. There are also on average 2.2 children under 5 years old per household. The overall rate of the initiation of breastfeeding within one hour is high at 61%

Children face significant challenges in **Health Services and Healthy Environment** in Tanzania. 41% of children have access to safe water and a mere 13% have access to safe sanitation facility, 5% use charcoal as cooking fuel as opposed to firewood and 78% live in households with earth, sand or dung floor. The average distance to a health facility is 4.4 kilometers in Tanzania. Less than half of all under 5 children live in households which consume adequately iodized salt.

There are huge disparities among households of the **Resources/Controls** they have. Slightly less than half of all mothers of children under 5 years old completed primary education and another 46% either never got to school or could not finish primary schooling. Only 8% children

[10] Here mothers actually mean individual children under five years old. It is used interchangeably because the wording would be otherwise lengthy, i.e. children who are born to mothers who.

have mothers who are able to attain some secondary education or higher. Sole or joint ownership of land by rural mothers with under 5 years old are less common at 34% and 9% respectively.

Summary statistics is also presented in Table 1 for children under 2 years old and children between 2 and 5 years old respectively. Most of the variables show similar patterns described above with a few exceptions. Vitamin A supplement increases across the two age groups from 50 per cent to 60 per cent. 2 to 5 years old are at much lower risk to develop childhood illnesses compared to the under 2 children more so for diarrhea than fever and acute respiratory infections.

There is an additional variable included in the under 2 years old sample. Approximately a quarter of children aged 0-23 months are fed according to recommended practices on Infant and Young Child Feeding (IYCF).

5. Results

This section presents the regression results from the linear probability models by the hierarchy of causes in the conceptual framework followed by heterogeneity analysis by age groups of children (see Table 2).

6.1. Immediate causes

When only immediate causes are included in specification (1), all food intake and food security variables are statistical significantly predicator of children's stunting status with the expected direction of correlation whereas children diseases have very small and statistical insignificant effects. To be specific, children under 5 years old living in households who eat three meals per day is 4.3 percentage points less likely to be stunted compared to those who only eat one or two meals per day. Children who living in households seldom or never experiencing any food insecurity are 3.6 and 4.9 percentage points less likely to have their children stunted compared to those reporting food insecure throughout the year. These effects are attenuated slightly when individual children's characteristics are introduced. But they are attenuated by around half and are no longer statistically significant when underlying causes on Care and Healthiness are included in the specification. When we further control for the basic causes of

stunting such as family wealth quintile and maternal education, all of the coefficient estimates continue to be reduced and remain statistically insignificant.

This overall picture belies the heterogeneity among the under 5 population. The food security significantly reduce the probability of stunted for children between 2 and 5 but are rather weak predictors for children under two years old even after controlling for all possible factors. In fact, results suggest that food security may even increase the chances of stunting for children under two.[11]

Childhood illness is not found to be associated with stunting but it is also the least well-measured risk factors in the survey data. Therefore we should be cautious on our inference.

6.2. Individual characteristics

Results show that boys are at 6 percentage points more likely to be stunted than girls, a difference constant across these specifications.[12] Being a younger sibling seems to increase the chance of stunting but only statistically significant for children less than two years old. It is found that one standard deviation increase in mother's height will reduce the chances of stunting by around 11 percentage points with the effects on under-2 children 3 percentage points smaller.[13]

6.3. Underlying causes

1. Care

Among the Care vector, a proxy of maternal nutrition, children's birth weight is the strongest predictor of stunting status. The probability of stunting for a child whose birth weight is larger than average is 10 percentage points lower than those who are reported as smaller than average at birth constant across the two age groups of children. Another measure of mother's

[11] I have to admit that this comes as a surprise. It is possible that relatively food secure household may be tempted to give complementary food too early and reduce intake of mother's breast milk.
[12] It is consistent with earlier findings on stunting in Sub-Saharan Africa (Wamani et al 2007). The literature I have seen so far is only speculative except one 2004 working paper at East-West Center in University of Hawaii looking at if it can be attributed to differential feeding practices or care in the context of India (Mishra, Roy, and Retherford, 2004).
[13] These results indicate strongly that some of the biological factors are most important risk factor for childhood stunting. It is worth noting particularly because it is outside the UNICEF conceptual framework.

maternal nutrition, body mass index is also negatively correlated with stunting although it has a much lower effect (1 percentage point). Mother's time spent working outside the household is another powerful predictor of children's stunting status. Compared with mothers who do not work at all, children with mothers who work either seasonably or full time is 5 percentage points more likely to be stunted. However, it seems to be primarily driven by the under-2 sample. Results also show that stunting rises with number of under 5 children in the family but declines with the total size of the household but primarily for the sample of two to five years old. Children's stunting status is a convex function of mother's age, suggesting that adolescent pregnancy is a risk factor for stunting. On the other hand, indicators on place of birth delivery, whether children were given vitamin A supplementation in the past six month and whether children sleep under bednet last night have no predictive power on stunting. All the coefficient estimates mentioned above are rather stable and not sensitive to the addition of healthy and resources variables.

2. Healthy environment

Access to safe water and sanitation seem to reduce the risk of being stunted but they are not statistically significant after controlling for the basic causes. These results have to be interpreted with caution because the water and sanitation questions are already used to generate the wealth indexes in TDHS.[14] Cleaner means of cooking fuel, poor floor materials, consumption of adequately iodised salt and distance to health facility remain insignificant predictor of stunting across all the specifications.

6.4. Basic causes

Mothers who finished secondary education or higher are 6 percentage points less likely to have stunted children. This effect is larger but also only statistically significant for under-2 sample only. There are no statistical significant difference between those with complete primary education and those below them.

[14] "The wealth index was constructed using household asset data and principal components analysis. Asset information was collected in the 2010 TDHS Household Questionnaire and covers information on household ownership of a number of consumer items, ranging from a television to a bicycle or car, as well as information on dwelling characteristics, such as source of drinking water, type of sanitation facilities, and type of materials used in dwelling construction" (TDHS Report, 2010).

Family wealth also shows a similar hurdle effects. There is no difference between the poorest and the second poorest quintile on stunting. The middle quintile seems to be doing better but the effect is not statistically significant. On the contrary, the rich quintile and the richest quintile are 6 percentage points less likely to have stunted children compared to the poorest quintile. The effects are primarily driven by results from the 2-5 years old sample. The rich wealth quintile and the richest wealth quintile are 10 and 19 percentage points less likely to have stunted children.

Landownership of mothers has no explanatory power on stunting.

6. Policy Implications and Recommendations:

Multivariate linear probability regression model is established to study the relative contribution of various risk factors identified by the UNICEF conceptual framework of malnutrition (1990). Empirical findings from the full sample of under 5 children indeed suggest that stunting is a manifestation of **multi-dimensional** factors as stipulated in the conceptual framework. In this section, we discuss the results in relation to the Productive Social Safety Net progrmame.

As shown in previous section, the determinants of stunting **vary by children's age**. For children less than 2 years old, stunting is more strongly determined by mother's work status, birth weight, mom's height, children's gender and mother's education attainment. Family wealth and food security are not significant predictors. In fact, children less than two years old from the relatively wealthy and better food endowed families seem to do worse on stunting.

In contrast, for children between 2 and 5 years old, wealth and food security factors become much stronger predictors of stunting than before. The size of the households and the number of under 5 in the family hold much more sway in determining stunting status than under 2 years old. The effect of height of mother on children's chance of stunting intensifies. So did birth weight variables.

It suggests that the caring from one's mother is most probably indispensable and irreplaceable at this early stage but as they age, substitute care can be sought to replace the

maternal care if there is such supply readily available to meet the demands in the households. This suggests that biology and maternal attention trump other more medium-term and long-term causes in the beginning of the children's life but as children age, family resources, food security and access to healthcare gradually start to exert their influence. It also provides evidence on the **cumulative effects of biological factors** as the correlation between mother's height and children's stunting status is much stronger for 2 to 5 years old compared to those below 2.[15]

What does this mean for the Productive Social Safety Net programme? How can PSSN utilize these evidences to make informed decisions about the design of their programme to achieve impact on stunting? First of all, the effects of cash transfer which is designed to improve food consumption may take time to affect children's anthropometric measures and for children younger than 2 years old, the effects may be very minimal. One has to be cautious also not to put burden on mother's time or distract mother's attention away from their children under 2 for collecting the cash (FAO, 2012). The detrimental effect of such a cash transfer will outweigh the benefits from additional incomes as shown in the paper. For older children, however, the tradeoff may be in the favor of cash against mother's time to care. Second, women with young children less than two years old should not be eligible for the Public Work Component or if they are indeed eligible, the time they can spend has to be limited not to compete with their time for breastfeeding and other care to the children. This is indeed practiced in Ethiopia's Productive Safety Net Programme (Save the Children 2012). Lesson could also be learned from the experience of Ethiopia's Tigray cash transfer programme supported by UNICEF which integrates community health extension services into the public work component (Save the Children 2012).

[15] This can be rephrased into intergenerational effects. I think what is interesting here is to try to link it with mother's age and make a stronger case of the links between the stunting risks associated with teenage pregnancy, lower education level of teenage girls (who drop out of school because of pregnancy) and consequent inadequate knowledge of appropriate IYCF practices and lower prospects of escaping the poverty trap with the vicious circle of stunting perpetuating itself across generations.

References:

1. Alderman H, H, Hoogeveen and M. Rossi M (2006). Preschool nutrition and Subsequent Schooling Attainment: Longitudinal Evidence from Tanzania. Mimeo.
2. Black RE, Cousens S, Johnson H, et al. Global, regional, and national causes of child mortality, 2008. Lancet 2010; 375: 1969–87.
3. Crookston BT, Penny ME, Alder SC, Dickerson TT, Merrill RM, Stanford JB, Porucznik CA, Dearden KA. 2010. Children who recover from early stunting and children who are not stunted demonstrate similar levels of cognition. Journal of Nutrition. 2010 Nov;140(11):1996-2001.
4. Food and Agriculture Organization. 2012. Social Protection and Nutrition.
5. James Garrett and Marcela Natalicchio. 2011. Working Multisectorally in Nutrition: Principles, Practices, and Case Studies.
6. Stuart Gillespie, Lawrence Haddad, Venkatesh Mannar, Purnima Menon, Nicholas Nisbett. 2013. The politics of reducing malnutrition: building commitment and accelerating progress The Lancet 10 August (Volume 382 Issue 9891 Pages 552-569 DOI: 10.1016/S0140-6736(13)60842-9)
7. Kavishe, 1993. Nutrition−Relevant Actions in Tanzania. UN ACC/SCN country case study supported by UNICEF United Nations Children's Fund. A case study for the XV Congress of the International Union of Nutritional Sciences, Adelaide.
8. Jef L. Leroy, Paola Gadsden & Maite Guijarro, (2012) The impact of daycare programmes on child health, nutrition and development in developing countries: a systematic review. Journal of Development Effectiveness 4:3, pages 472-496.
9. Marie T Ruel and Harold Alderman. 2013. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition?,the Maternal and Child Nutrition Study Group. The Lancet - 10 August (Vol. 382, Issue 9891, Pages 536-551) DOI: 10.1016/S0140-6736(13)60843-0
10. Save the Children. 2012. Realising the nutrition potential of social protection: progress and challenges.

11. Tanzania Food and Nutrition Center. 2004. Causes of malnutrition and Tanzania's nutrition programs past and present.
12. UNICEF, 1990. Strategy for improved nutrition of children and women in developing countries: a UNICEF policy review.
13. Henry Wamani, Anne Nordrehaug Åstrøm, Stefan Peterson, James K Tumwine and Thorkild Tylleskär. Boys are more stunted than girls in Sub-Saharan Africa: a meta-analysis of 16 demographic and health surveys. BMC Pediatrics 2007, 7:17.

Table 1. Summary Statistics for Children by Age Group

	Under 5 sample					Under 2 Sample					2-5 yrs old Sample				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Stunting==1	5017	0.419	0.494	0	1	2154	0.350	0.477	0	1	2863	0.472	0.499	0	1
Have three meals/day==1	5017	0.53	0.499	0	1	2154	0.531	0.499	0	1	2863	0.530	0.499	0	1
Often food insecure==1	5017	0.219	0.414	0	1	2154	0.217	0.412	0	1	2863	0.220	0.415	0	1
Sometimes food insecure==1	5017	0.208	0.406	0	1	2154	0.200	0.400	0	1	2863	0.214	0.410	0	1
Seldom food insecure==1	5017	0.197	0.398	0	1	2154	0.194	0.395	0	1	2863	0.199	0.399	0	1
Never food insecure==1	5017	0.377	0.485	0	1	2154	0.390	0.488	0	1	2863	0.367	0.482	0	1
Diarrhea in last 2 weeks	5017	0.14	0.347	0	1	2154	0.197	0.398	0	1	2863	0.097	0.297	0	1
Fever in last 2 weeks	5017	0.221	0.415	0	1	2154	0.244	0.430	0	1	2863	0.204	0.403	0	1
ARI in last 2 weeks	5017	0.075	0.263	0	1	2154	0.083	0.276	0	1	2863	0.068	0.252	0	1
Age of child in months	5017	28.45	17.184	0	59	2154	11.546	6.828	0	23	2863	41.164	10.281	24	59
Age of child in months squared	5017	1105	1034.714	0	3481	2154	179.913	163.539	0	529	2863	1800.129	853.720	576	3481
Male child==1	5017	0.497	0.500	0	1	2154	0.482	0.500	0	1	2863	0.509	0.500	0	1
Children's order of birth	5017	4.459	2.557	1	11	2154	4.083	2.528	1	11	2863	4.742	2.543	1	11
Mother's height for age in standard deviations	5017	-1.232	0.984	-4.81	3.66	2154	-1.233	0.984	-4.81	3.66	2863	-1.231	0.985	-4.48	3.66
Birth weight small==1	5017	0.075	0.264	0	1	2154	0.078	0.269	0	1	2863	0.073	0.260	0	1
Birth weight average==1	5017	0.742	0.438	0	1	2154	0.736	0.441	0	1	2863	0.746	0.435	0	1
Birth weight larger than average==1	5017	0.183	0.387	0	1	2154	0.185	0.389	0	1	2863	0.181	0.385	0	1
Body Mass Index of Mom	5017	22.13	3.368	12.08	41.36	2154	21.972	3.231	12.08	41.36	2863	22.249	3.464	14.54	41.36
Home delivery==1	5017	0.573	0.495	0	1	2154	0.563	0.496	0	1	2863	0.581	0.494	0	1
Size of households	5017	7.323	3.870	2	38	2154	7.435	4.203	2	38	2863	7.239	3.597	2	38
Number of under 5 children in hhlds	5017	2.269	1.291	1	13	2154	2.345	1.385	1	13	2863	2.211	1.213	1	13
Mom not working==1	5017	0.11	0.313	0	1	2154	0.115	0.319	0	1	2863	0.107	0.309	0	1
Mom working seasonally or occasionally==1	5017	0.65	0.477	0	1	2154	0.662	0.473	0	1	2863	0.641	0.480	0	1
Mom working all year long==1	5017	0.24	0.427	0	1	2154	0.223	0.416	0	1	2863	0.253	0.435	0	1

Vitamin A supplement last 6 months==1	5017	0.584	0.493	0	1	2154	0.500	0.500	0	1	2863	0.647	0.478	0	1
Children sleep under bednet==1	5017	0.784	0.412	0	1	2154	0.786	0.410	0	1	2863	0.781	0.413	0	1
Current age of mom	5017	29.84	7.120	15	49	2154	28.363	6.982	15	49	2863	30.958	7.020	16	49
Current age squared of mom	5017	941.3	446.018	225	2401	2154	853.164	418.681	225	2401	2863	1007.691	454.454	256	2401
Married or with partner==1	5017	0.882	0.323	0	1	2154	0.876	0.330	0	1	2863	0.886	0.318	0	1
Safe water==1	5017	0.417	0.493	0	1	2154	0.403	0.491	0	1	2863	0.428	0.495	0	1
Safe sanitation==1	5017	0.13	0.336	0	1	2154	0.136	0.343	0	1	2863	0.125	0.330	0	1
Earth, sand or dung floor==1	5017	0.812	0.391	0	1	2154	0.807	0.395	0	1	2863	0.816	0.388	0	1
Type of cooking fuel==charcoal	5017	0.047	0.211	0	1	2154	0.049	0.216	0	1	2863	0.045	0.207	0	1
Salt has 15 ppm of iodine==1	5017	0.453	0.498	0	1	2154	0.454	0.498	0	1	2863	0.453	0.498	0	1
Distance to nearest health facility	5017	4.275	5.071	0	51	2154	4.356	5.182	0	50	2863	4.215	4.986	0	51
Distance squared to nearest health facility	5017	43.99	134.122	0	2601	2154	45.818	132.579	0	2500	2863	42.619	135.278	0	2601
Mom has incomplete primary or below==1	5017	0.455	0.498	0	1	2154	0.452	0.498	0	1	2863	0.458	0.498	0	1
Mom has primary education==1	5017	0.466	0.499	0	1	2154	0.457	0.498	0	1	2863	0.473	0.499	0	1
Mom has secondary education or above==1	5017	0.078	0.269	0	1	2154	0.091	0.288	0	1	2863	0.069	0.253	0	1
Poorest quintile	5017	0.236	0.425	0	1	2154	0.236	0.425	0	1	2863	0.236	0.425	0	1
2nd poorest quintile	5017	0.274	0.446	0	1	2154	0.283	0.450	0	1	2863	0.268	0.443	0	1
Middle quintile	5017	0.247	0.432	0	1	2154	0.235	0.424	0	1	2863	0.256	0.437	0	1
Rich quintile	5017	0.194	0.395	0	1	2154	0.195	0.396	0	1	2863	0.194	0.395	0	1
Richest quintile	5017	0.048	0.213	0	1	2154	0.051	0.220	0	1	2863	0.045	0.208	0	1
Mom owning no land==1	5017	0.555	0.497	0	1	2154	0.596	0.491	0	1	2863	0.524	0.500	0	1
Mom owning land jointly==1	5017	0.357	0.479099	0	1	2154	0.327	0.469	0	1	2863	0.379	0.485	0	1
Mom owning land alone==1	5017	0.088	0.284048	0	1	2154	0.077	0.266	0	1	2863	0.097	0.297	0	1

Table 2: Full Regressions Tables by Age Group

	Under 5 sample					Under 2 sample					2-5 sample				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES															
Have three meals/day==1	-0.043***	-0.035***	-0.021	-0.018	-0.015	-0.033	-0.030	-0.020	-0.019	-0.017	-0.051***	-0.040**	-0.024	-0.018	-0.016
	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.018)	(0.018)	(0.018)	(0.019)
Sometimes food insecure==1	-0.010	-0.009	-0.009	-0.007	-0.004	0.076**	0.069**	0.065**	0.068**	0.072**	-0.074***	-0.069**	-0.063**	-0.060**	-0.060**
	(0.021)	(0.020)	(0.020)	(0.020)	(0.021)	(0.032)	(0.030)	(0.030)	(0.030)	(0.030)	(0.028)	(0.027)	(0.028)	(0.028)	(0.028)
Seldom food insecure==1	-0.036**	-0.026	-0.025	-0.021	-0.017	0.008	0.009	0.002	0.004	0.008	-0.069***	-0.059**	-0.053**	-0.046	-0.043
	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.032)	(0.030)	(0.030)	(0.030)	(0.031)	(0.029)	(0.028)	(0.028)	(0.028)	(0.028)
Never food insecure==1	-0.049***	-0.040**	-0.029	-0.021	-0.015	0.011	0.005	0.010	0.013	0.017	-0.088***	-0.078***	-0.062**	-0.050**	-0.042**
	(0.019)	(0.018)	(0.018)	(0.018)	(0.019)	(0.028)	(0.026)	(0.026)	(0.027)	(0.027)	(0.025)	(0.024)	(0.025)	(0.025)	(0.025)
Diarrhea in last 2 weeks	-0.005	0.004	-0.000	0.001	0.002	-0.001	-0.013	-0.018	-0.015	-0.016	0.046	0.026	0.026	0.026	0.030
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.027)	(0.026)	(0.026)	(0.026)	(0.026)	(0.032)	(0.031)	(0.031)	(0.031)	(0.031)
Fever in last 2 weeks	0.013	0.002	0.003	0.004	0.004	0.045*	0.025	0.025	0.027	0.028	-0.006	-0.010	-0.006	-0.007	-0.006

						(0.026									
	(0.018)	(0.017)	(0.017)	(0.017)	(0.017)	)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.023)	(0.023)	(0.023)	(0.023)
ARI in last 2 weeks	-0.016	-0.013	-0.009	-0.007	-0.007	-0.036	-0.038	-0.038	-0.034	-0.037	0.002	0.009	0.014	0.018	0.018
						(0.039									
	(0.028)	(0.027)	(0.027)	(0.027)	(0.027)	)	(0.036)	(0.036)	(0.036)	(0.036)	(0.039)	(0.038)	(0.039)	(0.038)	(0.038)
		0.027*	0.027*	0.027*	0.027*		0.013*	0.016*	0.015*	0.015*					
Age of child in months		**	**	**	**		*	**	**	*		0.004	0.003	0.002	0.004
		(0.001)	(0.001)	(0.001)	(0.001)		(0.005)	(0.006)	(0.006)	(0.006)		(0.008)	(0.008)	(0.008)	(0.008)
		-	-	-	-										
		0.000*	0.000*	0.000*	0.000*										
Age of child in months squared		**	**	**	**		0.000	0.000	0.000	0.000		-0.000	-0.000	-0.000	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
		0.062*	0.065*	0.064*	0.064*		0.078*	0.087*	0.086*	0.087*		0.049*	0.047*	0.048*	0.047*
Male child==1		**	**	**	**		**	**	**	**		**	**	**	**
		(0.013)	(0.013)	(0.013)	(0.013)		(0.019)	(0.019)	(0.019)	(0.019)		(0.018)	(0.018)	(0.018)	(0.018)
			0.009*												
Children's order of birth		0.002	*	0.008*	0.007		0.004	0.015*	0.014*	0.014*		0.000	0.004	0.002	0.001
		(0.003)	(0.005)	(0.005)	(0.005)		(0.004)	(0.008)	(0.008)	(0.008)		(0.004)	(0.006)	(0.006)	(0.006)
		-	-	-	-		-	-	-	-		-	-	-	-
Mother's height for age in		0.107*	0.108*	0.108*	0.108*		0.071*	0.071*	0.072*	0.073*		0.134*	0.134*	0.134*	0.134*
standard deviations		**	**	**	**		**	**	**	**		**	**	**	**
		(0.006)	(0.006)	(0.006)	(0.006)		(0.009)	(0.009)	(0.009)	(0.010)		(0.009)	(0.009)	(0.009)	(0.009)
			-	-	-										-
			0.058*	0.062*	0.064*								-	-	0.071*
Birth weight average==1			*	*	*			-0.043	-0.048	-0.044			0.064*	0.067*	*
			(0.025)	(0.025)	(0.025)			(0.036)	(0.036)	(0.036)			(0.035)	(0.034)	(0.035)
			-	-	-			-	-	-			-	-	-
Birth weight larger than			0.098*	0.104*	0.108*			0.100*	0.106*	0.102*			0.096*	0.101*	0.110*
average==1			**	**	**			*	**	*			*	**	**
			(0.028)	(0.028)	(0.028)			(0.040)	(0.040)	(0.041)			(0.039)	(0.039)	(0.039)
			-	-	-			-		-			-	-	-
			0.012*	0.011*	0.010*			0.006*	-	0.006*			0.015*	0.013*	0.012*
Body Mass Index of Mom			**	**	**			*	0.006*	*			**	**	**

	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Home delivery==1	0.015	0.008	0.008	0.003	-0.001	-0.004	0.020	0.011	0.011
	(0.014)	(0.014)	(0.014)	(0.021)	(0.021)	(0.021)	(0.019)	(0.019)	(0.019)
	-	-	-				-	-	-
	0.007*	0.007*	0.006*				0.010*	0.010*	0.008*
Size of households	**	**	*	-0.004	-0.003	-0.004	**	**	*
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of under 5 children in	0.018*						0.034*	0.031*	0.029*
hhlds	*	0.015*	0.014*	0.002	-0.002	-0.002	**	**	*
	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Mom working seasonally or	0.067*	0.053*	0.045*	0.154*	0.143*	0.140*			
occasionally==1	**	*	*	**	**	**	0.008	-0.011	-0.019
	(0.021)	(0.021)	(0.022)	(0.028)	(0.029)	(0.029)	(0.030)	(0.031)	(0.030)
	0.048*	0.046*	0.046*	0.120*	0.118*	0.116*			
Mom working all year long==1	*	*	*	**	**	**	-0.002	-0.006	-0.003
	(0.024)	(0.024)	(0.024)	(0.032)	(0.032)	(0.032)	(0.033)	(0.033)	(0.033)
Vitamin A supplement last 6				-					
months==1	-0.007	0.003	0.005	0.040*	-0.030	-0.028	0.006	0.017	0.019
	(0.014)	(0.015)	(0.015)	(0.022)	(0.022)	(0.023)	(0.019)	(0.020)	(0.020)
Children sleep under bednet==1	-0.017	-0.011	-0.010	-0.002	0.002	0.001	-0.032	-0.026	-0.026
	(0.016)	(0.016)	(0.016)	(0.023)	(0.023)	(0.023)	(0.022)	(0.022)	(0.022)
	-		-	-	-	-			
	0.016*	-	0.016*	0.030*	0.028*	0.027*			
Current age of mom	*	0.015*	*	**	*	*	-0.005	-0.004	-0.006
	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
				0.000*	0.000*	0.000*			
Current age squared of mom	0.000*	0.000*	0.000*	*	*	*	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married or with partner==1	-0.001	-0.004	-0.003	0.022	0.018	0.028	-0.023	-0.023	-0.029
	(0.021)	(0.021)	(0.021)	(0.029)	(0.029)	(0.030)	(0.029)	(0.029)	(0.030)
		-							
Safe water==1		0.028*	-0.021		-0.030	-0.031		-0.021	-0.010
		(0.014)	(0.014)		(0.020)	(0.021)		(0.019)	(0.019)

	-					
Safe sanitation==1	0.036*	-0.019	-0.040	-0.051	-0.028	0.008
	(0.021)	(0.023)	(0.030)	(0.032)	(0.030)	(0.032)
Earth, sand or dung floor==1	0.023	-0.019	-0.007	0.019	0.050*	-0.032
	(0.019)	(0.027)	(0.028)	(0.040)	(0.026)	(0.035)
					-	
Type of cooking fuel==charcoal	-0.020	-0.006	0.043	0.021	0.075*	-0.028
	(0.032)	(0.033)	(0.046)	(0.049)	(0.043)	(0.045)
Salt has 15 ppm of iodine==1	-0.008	-0.007	-0.013	-0.014	-0.001	0.001
	(0.013)	(0.013)	(0.019)	(0.020)	(0.018)	(0.018)
Distance to nearest health facility	0.003	0.003	0.005	0.005	0.003	0.002
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Distance squared to nearest health facility	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mom has primary education==1		0.014		-0.009		0.032
		(0.014)		(0.021)		(0.019)
		-				
Mom has secondary education or above==1		0.056*		-		
		*		0.070*		-0.034
		(0.028)		(0.038)		(0.040)
2nd poorest quintile		-0.008		-0.005		-0.008
		(0.019)		(0.028)		(0.026)
Middle quintile		-0.028		-0.014		-0.034
		(0.020)		(0.030)		(0.028)
		-				-
		0.060*				0.104*
Rich quintile		*		0.015		**
		(0.029)		(0.044)		(0.039)
						-
						0.193*
Richest quintile		-0.063		0.110		**

					(0.049)					(0.073)					(0.066)
Mom owning land jointly==1					0.009					-0.027					0.030
					(0.015)					(0.023)					(0.021)
Mom owning land alone==1					0.004					0.019					-0.003
					(0.025)					(0.038)					(0.032)
Constant	0.469**	-0.026	0.487**	0.442**	0.488**	0.339***	-0.014	0.479**	0.471**	0.449*	0.557**	0.416**	0.894**	0.818**	0.873**
	(0.017)	(0.027)	(0.126)	(0.129)	(0.131)	(0.025)	(0.040)	(0.174)	(0.179)	(0.182)	(0.022)	(0.159)	(0.248)	(0.251)	(0.252)
Observations	5,017	5,017	5,017	5,017	5,017	2,154	2,154	2,154	2,154	2,154	2,863	2,863	2,863	2,863	2,863
R-squared	0.004	0.111	0.127	0.130	0.132	0.006	0.132	0.154	0.158	0.161	0.009	0.096	0.115	0.121	0.126

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1