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The Link between Rural Household Food Security and Child Nutrition: Evidence from Gubalafto District of North Wollo Zone, Ethiopia

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Abstract:

The objective of this study is to examine the link between household food security and child nutrition in drought prone in rural Gubalafto district, Ethiopia. The study used two stage sampling to draw pairs of 230 household and children aged from 6 to 59 months. Household food security status was measured by Direct Consumption Indicator (DCI), Food Consumption Score (FCS) and Household Food Insecurity Access Scale (HFIAS) indicators. Child nutritional status was measured using anthropometric indicators weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ) and weight-for-height Z-score (WHZ) and children whose Z- scores were below -2 standard deviation was categorized as underweight, stunted and wasted respectively. Accordingly, the study found that 46.1%, 51.74 and 49.6 % of households were found to be food insecure as measured by DCI, HFIAS and FCS respectively. About 34.3%, 54.3 and 13.9 % of children were found to be underweight, stunted and wasted respectively. The bivariate analysis showed that household food security status was significantly associated with underweight and stunting and but wasting was not. DCI and FCS positively and HFIAS negatively and significantly correlated with WAZ and HAZ but not with WHZ. Households with normal children had better kilocalorie consumption and FCS and lower HFIAS. Therefore, the study confirms the existence of a link between household food security status and children

underweight and stunting. Our findings suggest the need for improving household food security and other socio economic wellbeing of households to improve child nutrition.

Key words: Child nutrition, rural food security, Gubalafto, Ethiopia

1. INTRODUCTION

Ethiopia is one of the least developing countries where poverty, food security and malnutrition are prevalent. About 85% of population live on rural areas where poverty is more pronounced. For the last decade the country has shown remarkable economic growth and reduction of poverty, hunger and malnutrition though the prevalence of poverty, food insecurity and malnutrition are still high and above most Sub-Saharan African countries. About 29.6% of the population live on below national poverty line, 36.8 % of the people live on less than 1.25USD and 72.2% of the people live on less than 2USD a day in 2011 (World Bank, 2014). Around 34.7% of rural population live below food poverty line in 2011(MoFED, 2012). Prevalence of child malnutrition is also among the highest in the word and above average Sub Saharan African countries; 44%, 10% and 29% of children under 5 years old are stunted, wasted and underweight respectively in 2011(CSA and WFP, 2014). To reduce chronic poverty, food insecurity and malnutrition, the country formulated food security programs in 1996 and national nutrition programs in 2008 which are active in the study area.

Amhara regional state, where the current study is located, is the 2nd populous regional state and has the highest prevalence of poverty, food insecurity and child malnutrition. About 42.5% and 49% of rural population of Amhara state live below national food poverty line and 2550 kcal per adult equivalent (MoFED, 2012; CSA and WFP, 2014). The

estimation of stunting, wasting and underweight in Amhara regional state was 52%, 10% and 33% respectively in 2011. Gubalafto district is one of drought prone areas in Amhara regional state and synonymous with famine and chronic food insecurity since 1960s.

Food security, as defined by world food summit 1996, is "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". This definition implies that sufficient access to adequate nutrition and safe food supply at the household level and at individual level in the household is required to ensure food security (HKI (2010); Coates et.al (2006); Nord et.al (2003). The relationship between household food security and nutritional status of children are least studied in developing countries. Such relationships are mostly studies in developed countries to assess the effect over excessive weight (obesity) (Santosa and Gigante, 2013). The aim of this study is to examine the relationship between rural household food security and anthropometric indicator of child nutrition in Gubalafto district of Ethiopia. The rest of the paper is organized as follows. Section two introduces methodology, section three presents result and discussion, and finally conclusion are made.

2. METHODOLOGY

Description of the study area

Gubalafto district is located in north east of Ethiopia in Amhara Regional State between $39^{0}12'9"$ and $39^{0}45'58"$East and $11^{0}34'54"$and $11^{0}58'59"$North. The elevation ranges from 1330 to 3900 meters above sea level. The topography is characterized by 35% mountainous, 30% undulating, 20% flat, and 15% gorges or Valleys. The district is one of dropt prone

area and chronically food insecure districts in Amhara Regional State. The district gets annual rainfall between 500- 800 mm and has bimodal characteristics. The small rainy season (*Belg*), occurs between March and May and the long rainy season (*Meher*), occurs between June and September. In most cases, for crop production, the highland areas (*Dega*) depend on *Belg* rain whereas, the *Woinadega* and *Kolla* areas depend on *Meher* rain. The rain is so erratic, short in duration and poorly distributed in duration and spatially. The temperature ranges from 13.5 to 25.4^0C. The district has a total population of 139,825 in 2007 with an area of 900.49 square kilometers and a population density of 155.28(CSA, 2007). Mixed farming (crop and animal production) is widely practiced in the district. In general, the district has two distinct livelihood zones (MoARD, 2007): the North Wollo East Plain Livelihood Zone (**NWE)** or *Meher* dependent and North Wollo Highland Belg Livelihood Zone **(NHB) or** *belg* dependent**.** Close to 95% of the population of the district lives in **NWE** *kebeles* and relatively believed to be food sufficient livelihood zone than NHB. The district is one of the beneficiaries of Productive Safety Net Program.

Data

The study used two stage stratified sampling to select pairs of 230 households and children aged 6 to 59 months. Four *kebles*[1](villages) randomly selected, one from **NHB** livelihood zone and 3 from **NWE** livelihood zone since majority of population is reside in **NHB** livelihood zone. Systematic sampling was used to select households from each of the *kebeles* taking into account the share of inhabitants in each kebele. In short, n^{th} of the household were selected from health extension workers household registration pad. Simple random sampling was made in the selection of the first household in each *kebeles*.

[1] *kebele* refers to lowest administrative unit in Ethiopia

Two trained health extension workers were responsible to collects data in each *kebeles*. All information was taken from households' respective homes.

Measuring household food security and child nutrition

To measure the prevalence of household food insecurity, the study used three different indicators of household food security to capture quantity, quality and accessibility dimension of food security; namely, Direct Consumption Indicator (DCI), Food Consumption Score (FCS) and Household Food Insecurity Access Scale (HFIAS indicators). In DCI the study used 2100 kilocalorie (kcal) consumption per day per adult equivalent as a threshold to determine food secure and insecure households (see in Appendix 1 types of food and conversion factors).

FCS was calculated based on WFP (2008) formula. It takes into account diet diversity, frequency and nutritional importance of food types. The frequency of 8 food types is multiplied by its weights or nutritional importance (i.e., staples (2), pulses (3), vegetables (1), fruits (1), meat/fish/egg (4), milk (4), sugar (0.5), and oil (0.5)) and then summed to create the FCS. The score ranges from 0 to 112; '0" when a household didn't consume any food in the last 7 days and 112 when household consumed each food groups all days for the last 7 days. The higher the score, the more food secure a household was. The FCS has three consumption categories; a household can be considered as "poor" if the score is below 21; "borderline" if the score is between 21 and 35 and "acceptable" if the score is above 35. In this study households who scored below 35 were considered as food insecure and above 35 as food secure.

HFIAS is a method used to assess whether the household experienced problem with food access for the last one month based on nine standard questions (see in Appendix 2). The score ranges from 0 if the households response for all questions are "no" and 27 if household response "often" for all

occurrence of questions. The higher HFIAS, the more food insecure a household was. Following FAO (2008) a household can be considered as food secure if household experiences none of the food insecurity (accessibility) conditions, or experiences worry but rarely. In other words a household can be considered as food secure if the response for question number 1 is "none" or "rarely" and for the rest questions "none". Otherwise the household can be considered as food insecure.

Three commonly used anthropometric indices were used to determine child nutritional status. The weight-for-age *Z*-score(WAZ), height-for-age *Z*-score (HAZ) and weight-for-height *Z*-score (WHZ) to measure the prevalence of underweight, stunting and wasting, respectively. To do this, height was measured using 130 cm long, not collapsible made of wood meter and recorded to the nearest 0.1 centimetre. Weight was measured by using a calibrated 25 kilogram hanging spring type Salter scale and recorded to the nearest 0.1 kilogram. The ages of the children were calculated in months based on maternal recall of exact birth dates or ages in completed months. When this was not possible the survey team used birthdates recorded in immunization cards or birth certificates. The three anthropometric indices height-for-age, weight-for-age and weight-for-height were transformed into Z score. Following World Health Organization (WHO) classification, a child whose Z score below -2 is considered as stunted, underweight and wasted based on HAZ, WAZ, and WHZ, respectively.

Statistical analysis

Both univaraiet and bivariate analysis were used in the study. In univariate analysis, Mean, Standard Deviation (SD), Percentages were used to describe household food security and child nutritional status. In bivariate analysis, Pearson chi square test, t test, and correlation were used to evaluate the association of household food security and child nutritional

status when it found necessary. The ENA (2010) and STATA (13) software were used for statistical computation and analysis.

3. RESULTS AND DISCUSSIONS

Household food security status

Table 1 shows prevalence of household food insecurity as measured by different indicators. About 46.1% of households were found to be food insecure based on DCI of 2100 kcal per adult per day cut off. The mean kilocalorie consumption in the district was found to be 2712 with high intra household variation (SD=712), which is below the 2011 mean kilocalorie consumption of rural national (3164) and ARS (2758). In terms of HFIAS indicator, about 51.74% of households found to be food insecure having the mean score of 6.1 and high intra household variation (SD=6.2). Almost half of household were found to be food insecure based on FCS indicator, which is above average rural national (29%) and Amhara Regional State (12%) in the same indicator in 2011. Large number of households consumed less variety of foods and relied on staples and pulses. The mean FCS was 31.7 with standard deviation of 7.6. In general, the food insecurity in the district was high and deep and the prevalence of food insecurity was higher than rural national and Amhara Regional State estimation of 2011 as measured by DCI (daily per adult equivalent kilocalorie consumption) and FCS indicators.

Table 1: Prevalence of household food insecurity

Indicators	Prevalence of food insecurity	Mean of scales
DCI	46.1	2717
		(712)
HFIAS	51.74	6.1
		(6.2)
FCS	49.6	31.7
		(7.6)

Note: figure in parenthesis are standard deviations
Source: own field survey, 2014

Children nutritional status

Table 2 provides prevalence of child malnutrition and mean Z score of WAZ, HAZ and WHZ. About 34.3%, 54.3% and 13.9% of children were underweight, stunted and wasted respectively in the study area. According to WHO (2000) classification of severity of malnutrition in a community for children under 5 years of age, the prevalence of wasting and stunting in the district is considered as "serious" public health problem, while underweight is considered as "critical". Moreover, compared to recent estimation (2011) of national and Amhara Regional State under five child malnutrition prevalence, the district had higher prevalence of child malnutrition. At national level (rural) the prevalence of wasting, stunting and underweight was 10%, 46%, 30.4% respectively, while in Amhara Regional State the prevalence of child malnutrition was 10%, 52% and 33% for the same indices of wasting, stunting and underweight respectively in 2011(CSA and FAO, 2014). The mean Z score of WAZ, HAZ and WHZ in the district found to be-1.55 ±1.2, -1.87±1.31 and -0.72±1.31 respectively. The negative mean Z score of all nutrition indicators indicate the poor nutritional status of children in the district.

Table 2: Prevalence of child malnutrition

Indicators	Prevalence of food insecurity	Mean of scales
WAZ(underweight) (<-2 z-score)	34.3	-1.55 (1.20)
HAZ(stunting) (<-2 z-score)	54.3	-1.87 (1.21)
WHZ (wasting) (<-2 z-score)	13.9	-0.72 (1.21)

Note: figure in parenthesis are standard deviations
Source: own field survey, 2014

Association of household food security status and child nutritional status

Table 3 provides the association of household food security and child nutrition. The prevalence of child malnutrition was lower in food secure households than their counterparts. As shown in the table 3, the prevalence of child malnutrition was found to be 28.2%, 41.9% in term of WAZ, HAZ and WHZ, respectively in food secure households, while 41.5%, 68.9%, and 15.1% in food insecure households for the same indices of underweight, stunting and wasting respectively as household food security status is determined by DCI. The chi square test also confirmed that there is significance association between household food security status and child nutrition status in underweight and stunting indicators ($X^2(1) = 4.4718$, Pr = 0.034 and X^2 (1) = 16.7073, Pr = 0.000 respectively) but not in wasting indicator (X^2 (1) = 0.2291, Pr = 0.632).

Table 3: Prevalence of child malnutrition by household food security status

	DCI		HFIAS		FCS	
	Food secure N (%)	Food insecure N (%)	Food secure N (%)	Food insecure N (%)	Food secure N (%)	Food insecure N (%)
WAZ						
Underweight	35(28.2)	44(41.5)	30(27)	49(41.2)	31(26.7)	48(42.1)
Normal	89(71.8)	62(58.5)	81(73)	70(58.8)	85(73.3)	66(57.9)
	$X^2(1) = 4.4718$, Pr = 0.034		X^2 (1) = 5.0989,Pr = 0.024		X^2 (1) = 6.0320, Pr = 0.014	
HAZ						
Stunted	52(41.9)	73(68.9)	47(42)	78(65.5)	56(48.3)	69(60.5)
Normal	72(58.1)	33(31.1)	64(57.7)	41(34.5)	60(51.7)	45(39.5)
	X^2 (1) = 16.7073, Pr = 0.000		X^2 (1) = 12.4629, Pr = 0.000		X^2 (1) = 3.4777, Pr = 0.062	
WHZ						
Wasted	16(12.9)	16(15.1)	13(11.7)	19(16)	13(11.2)	19(16.7)
Normal	108(87.1)	90(84.9)	98(88.3)	100(84)	103(88.8)	95(83.3)
	X^2 (1) = 0.2291, Pr = 0.632		X^2 (1)=0.8680, Pr = 0.352		X^2 (1) =1.4309, Pr = .232	

Source: own field survey, 2014

Household food security status based on HFIAS makes a difference in child nutrition status. As clearly shown in table 3, the prevalence of child malnutrition was higher in food insecure households than food secure households. About 41.2%, 65.5% and 16% of children were underweight, stunted and wasted respectively in food insecure households while 27%, 42%, and 11.7% of children were underweight, stunted and wasted respectively in food secure households. The chi square test depicts that there is significant association between household food security and child nutritional status in case of underweight and stunting but not in wasting (X^2 (1) = 5.0989,Pr = 0.024. X^2 (1) = 12.4629, Pr = 0.000; X^2 (1) =0.8680, Pr = 0.352 for underweight, stunting and wasting respectively).

Household food security status as measured by FCS was associated with child nutritional status. As shown in table 3, high prevalence of child malnutrition was more associated with food in secure households. The prevalence of underweight stunting and wasting were found to be 42.1%, 60.5% and 21% respectively in food insecure households, while 26.7%, 48.3 and 6.9 % in food secure households for the same indices respectively. As indicated by chi square test the difference in prevalence of child nutrition was statistically significant in underweight and stunting (X^2 (1) = 6.0320, Pr = 0.014 and X^2 (1) = 3.4777, Pr = 0.062, respectively). However, it was not significantly associated with wasting (X^2 (1) =1.4309, Pr = 0.232).

In general, household food security as measured by DCI and HFIAS and FCS was significantly associated with underweight and stunting but not with wasting. This may be due to the fact that acute (wasting) malnutrition is affected by other factors in addition to food such as hygiene and sanitation, child caring and diseases. These finding of this study is consistent with that of Nasser et al (2014) and Hackett et al.

(2009) who found that food security is associated with stunting and underweight but wasting was not.

Table 4 presents mean kilocalorie consumption per day per adult in households who have malnourished and normal children. The mean kilocalorie consumption level of households with malnourished children was 2494kcal with standard deviation of 126 in WHZ; 2559kcal with standard deviation of 63.1 in HAZ; and 2556.4kcal with standard deviation of 740.8 in WAZ, while for those households who had normal children was 2753kcal with standard deviation of 50.3; 2905.2kcal with standard deviation of 65.9 and 2801kcal with standard deviation of 684.1 in WHZ, HAZ, and WAZ indicators respectively. The t test confirms that there was significant mean difference between households who had malnourished and normal children with regard to daily per adult kilocalorie consumption (t=-1.9208, Pr=0.056; t=-3.7779, Pr=0.0002 and t=-2.502, Pr=0.0131 for wasting, stunting and underweight respectively). Hence, those households who had malnourished children had lower consumption than their counterparts.

FCS shows the score of the quality and frequency of household consumption of different foods which had been taken by households for the last month before the commencement of survey. The quality and frequency/quantity of food consumption have an impact on food security, nutrition and health status of household members including children. Especially mother's quality and quantity of food consumption have a great impact on early age of children nutritional status. The Higher FCS represents a lower level of food insecurity in the household and children too.

Table 4: relationship of household food security indicators and child nutritional status

Variable	Stat	WHZ		HAZ		WAZ	
		malnourished	Normal	malnourished	Normal	malnourished	Normal
Consumption	Mean	2494	2753	2559	2905.2	2556.4	2801
	SD	126	50.3	63.1	65.9	740.8	684.1
	t value	-1.9208		-3.7779		-2.502	
	p value	0.056		0.0002		0.0131	
FCS	Mean	24.5	26.9	25.2	28.3	25.7	27.1
	SD	6.2	6.7	6.0	7.1	7.7	6.0
	t value	-1.8917		-3.6037		-1.5276	
	p value	0.0598		0.0004		0.1280	
HFIAS	Mean	7.09	6.40	6.92	5.99	7.13	6.17
	SD			2.554566	2.5476	3.04	2.26
	t value	1.4122		2.7521		2.7114	
	p value	0.1593		0.0064		0.0072	

Source: own field survey, 2014

The mean FCS of households who had malnourished children was lower than those households who had normal children. The mean FCS in malnourished children's' household was 24.5, 25.2 and 25.7 based on wasting, stunting and underweight indices respectively, whereas in normal children's household the mean FCS was found to be 26.9, 28.2 and 27.1 for the same indices of wasting, stunting and underweight respectively. Their mean difference was also statistically significant in wasting and stunting indicators (t=1.8917, Pr = 0.0598 and t = -3.6037, Pr =0.0004 respectively) but not statistically significant in underweight indicator (t= -1.5276, Pr=0.1280).

As shown from the table 4, the mean HFIAS of households who had malnourished children was higher than those households who had normal children. The t test also confirms that there was significance mean difference between nutritional status of children in terms of HFIAS of household in stunting and underweight (t=2.7521, Pr=0.0064 and t= 2.7114, Pr=0.0072 respectively) but not statistically significant in wasting indicator (t=1.4122, Pr=0.1593).

Therefore, from the above analysis of food insecurity indicators and child nutritional status, we can conclude that those households with normal children are more likely to have

better kilocalorie consumption and FCS and lower score of HFIAS.

The Pearson correlation test was run to examine the directional relationship and strength of correlation between household food security indicators and child nutrition indicators. As seen from in table 5, each indicators of food security i.e. consumption of kilocalorie, FCS and HFIAS had their expected theoretically consistent correlation sign with child nutritional indicators. Kilocalorie Consumption and FCS indicators were positively correlated with all indicators of wasting, stunting and underweight, while HFIAS were negatively correlated with all indices of child nutrition status as expected. All household food insecurity indicators were significantly correlated with underweight and stunting up to 5% level of significance. Surprisingly, all household food insecurity indicators were not significantly correlated with acute (wasting) malnutrition indicator. Moreover, the strength of correlation was relatively stronger in underweight, mediocre in stunting and weaker in wasting.

Table 5: Correlation between household food security indicators and child anthropometric indicators

Variables	WAZ	HAZ	WHZ
Consumption	0.2077	0.1699	0.0910
	(0.0015)	(0.0098)	(0.1691)
FCS	0.1591	0.1340	0.0651
	(0.0158)	(0.0424)	(0.3259)
HFIAS	-0.2039	-0.1444	-0.1106
	(0.0019)	(0.0285)	(0.1942)

Note: figure in parenthesis are p values
Source: own field survey, 2014

4. CONCLUSION

The prevalence of food insecurity and child malnutrition was high in the district above average rural national rural and Amhara Regional State in comparable indicators. According to

WHO severity classification both underweight and stunting is considered as 'serious" public health problem and wasting is considered as "critical". The bivariate analysis indicated that household food security was more associated with underweight and long term indicator of chronic (stunting) child nutrition. Food insecurity indicator DCI and FCS was positively and significantly correlated with WAZ and HAZ, while HFIAS was negatively and significantly correlated with WAZ and HAZ. However, food insecurity indicators were not significantly correlated with WHZ. The less association of household food security and short term acute (wasting) malnutrition suggests that child wasting may not be influenced in availability or accessibility of food at household level alone, rather other factors such utilization of food, child caring, hygiene and sanitation may also contribute for acute malnutrition. Therefore, it is recommended that improving household food insecurity is important to improve child nutrition; however, it should be accompanied by improving overall socio economic wellbeing of households.

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Appendix 1: Ethiopian food conversion factor

Food items	Calorie per 100 gram or mili litre
Teff	335
Wheat	340
Maize	344
Barely	370
Rice	335
Potato	75
Onion	38
Tomato	22
Beans and peas	310
Lentil	325
Vegetables	75
Dry pepper	73
Edible oil(litre)	900
Milk(litre)	79
Butter	700
Meat	626
Sugar	375
Coffee	119

Source: FAO and Ethiopian Health and Nutrition Research Institute

Appendix 2: HFIAS questions

Please answer whether this happened **never**, **rarely (once or twice)**, **sometimes (3 to 10 times)** or **often (more than 10 times)** in the past 30 day

1	Did you worry that your household would not have enough food due to a lack of resources?
2	Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?

3	Did you or any household member have to eat a limited variety of foods due to a lack of resources?
4	Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?
5	Did you or any household member eat a SMALLER MEAL than you felt you needed because there was not enough food?
6	Did you or any household member eat FEWER MEALS in a day because there was not enough food?
7	Was there ever no food at all in your household because there were not resources to get more?
8	Did you or any household member go to sleep at night hungry because there was not enough food?
9	Did you or any household member go a whole day without eating because there was not enough food?