

Nutritional status of children among irrigation user and non-user households in Hintalo Wajirat Woreda, Tigray, Ethiopia: A Cross Sectional Study

Medhanye Habtetsion^{*1}, Akberet Lemlem¹, Afework Mulugeta², Azeb Gebresilasie² and Sintayehu Abate Temesgen¹

¹ Ethiopian Public Health Institute, P.O.BOX 1242, Addis Ababa, Ethiopia

² Mekelle University College of Health Science

* Corresponding author: medhanyeh@gmail.com

Abstract

Introduction: Various studies have indicated the positive impact of irrigation systems on productivity. However, its impact on improved growth and nutritional status of under-five children from smallholder farmers is still under investigation.

Objective: To assess nutritional status and factors associated with under nutrition among 6 - 59 months aged children in irrigation user and non-user households in Hintalo Wajirat Woreda, Tigray, Ethiopia.

Materials and Methods: A cross-sectional study was conducted from March to April 2013 among a total of 802 children 6 – 59 months age (400 irrigation user and 402 non-user households). A stratified multistage sampling technique was employed to select the households. Structured questionnaire was used to collect primary data. The associations between variables were analyzed using bivariate and multivariable logistic regression. Data was analyzed using ENA-SMART and SPSS version 20.

Results: The prevalence of stunting, underweight and wasting in children from irrigation non-users was 68.2%, 43.8%, and 14.4% while among users was 56.8%, 34.0% and 6.5%, respectively. Failure to consume milk and milk products (AOR 1.957, 95%CI: 1.079, 3.549), walking for more than an hour to fetch drinking water (AOR 2.452, 95% CI: 1.446, 4.157), and perceived birth size (AOR 0.267, 95%CI: 0.144, 0.498) were factors associated with stunting in children from irrigation non-user households. Distance to the site of irrigation (AOR 2.643, 95%CI: 1.148, 6.084), perceived birth size and intake of dairy products (AOR 1.773, 95%CI: 1.138, 2.762) and potato and other tubers (AOR 2.219, 95%CI: 1.228, 4.011) in the last 24 hours preceding the data collection were factors associated with underweight in children from the irrigation user households. Similarly, child age (AOR 2.103, 95%CI: 1.326, 3.336), intake of dairy products (AOR 2.301, 95%CI: 1.44, 3.677) and formula milk (AOR 2.569, 95%CI: 1.034, 6.384), sell of agriculture products (AOR 2.466, 95%CI: 1.43, 4.25) and availability of toilet (AOR 1.566, 95%CI: 1.001, 2.45) were associated with underweight in children from irrigation non-user households. Children from families who failed to consume legume and legume products in the last 24 hours preceding the survey (AOR 3.033, 95%CI: 1.307, 7.042), children 24-59 months of age were (AOR 0.248, 95%CI: 0.104, 0.591), possession of oxen (AOR 2.355, 95%CI: 1.198, 4.630) and avoidance of pre lacteal feeding within three days after delivery (AOR 0.345, 95%CI: 0.137, 0.868) were factors associated with child wasting in irrigation user households.

Conclusions: Child malnutrition was highly prevalent in Hintalo Wajirat Woreda. Children from the irrigation user households have better nutritional status compared to children from the irrigation non-user households suggesting that agricultural interventions are important in bringing about improvement of child nutritional status in populations with similar setting.

Introduction

Malnutrition in all its forms is closely linked, either directly or indirectly, to major causes of death and disability worldwide. Worldwide, in 2011, about 101 million and 165 million children under 5 years of age were underweight and stunted, respectively. The prevalence of stunting, underweight, and wasting is decreasing in most areas of the world, however, in most African countries, stunting is still a major public health concern (WHO 2013).

Under nutrition is the underlying cause for most deaths associated with severe infections like malaria, measles, pneumonia, diarrhea and other childhood illnesses (CSA

2005; CSA 2012). While most nutrition interventions are delivered through the health care sector, non-health or nutrition sensitive interventions such as agriculture, rural development, water supply, and sanitation, social protection, education and gender are also critical in improving the nutritional status of communities (World Bank 2006). Among the nutrition sensitive interventions, agricultural interventions aimed at boosting agricultural productivity of cereals/grains, legumes, vegetables and fruits. Effective programs for improving agricultural productivity would have a potentially positive impact on household and child nutritional status (Torlesse et al. 2003; Kerr et al. 2011). However, most rural communities in Ethiopia rely on rain-fed agriculture for

production of staple crops. The struggle to secure food in Ethiopia can be greatly assisted by increasing production using irrigation water from small-scale, medium or large-scale irrigation (Abdurahman 2009). Since most farmers from in Ethiopia produce only once a year, a long dry spell or drought can lead to chronic food shortage and malnutrition. Full or supplementary irrigation is therefore required to minimize the risk of crop failure and hence irrigation can be considered as an option to support the unreliable rain fed agriculture (Steenbergen et al. 2011). Thus, promotion of irrigation, smallholder irrigation in particular, is considered to be a feasible strategy for achieving household food security (Polak and Yoder 2006; Notenbaert et al. 2012; Webb and Block 2012). Of course, ensuring food security alone can aid in reducing hunger but cannot eliminate malnutrition or impact nutritional status largely if other components such as safe drinking water and health care are not envisaged (Berti et al. 2003).

Studies on the on the effects of improved agricultural productivity and impact of irrigation on the nutritional status of under-five children are inconsistent (Benefice and Simondon 1993; Parent et al. 2002 ; Berti et al. 2003; Veronicah et al. 2007). on improving nutritional status. Some studies still recommended the need for more researches on the effect of agricultural intervention in improving nutritional status of children (Masset et al. 2012; Webb and Block 2012). The impact of irrigation on nutritional outcomes of children is not answered unequivocally in the Ethiopian context. Thus, this study was designed to assess the nutritional status of under-five children among irrigation user and non-user households from rural communities of Hintalo-Wajirat Woreda of Tigray Region.

Materials and Methods

Study design, period and population: Community based cross sectional study design was conducted in Waza Adiawena and May Nebri Kebeles of Hintalo Wajirat Woreda, which are located in the South Eastern part of Tigray; 51 kms from the regional capital Mekelle. According to CSA 2007/8, the total population is projected to be 152,219. Less than 10% of the population live in urban areas and around 90% live in the rural areas of the wereda (CSA 2005). In Waza Adiawena, there were 1072 irrigation user households from a total of 1914 households while May Nebri had only 221 irrigation user households from a total of 1586 households. The study was conducted from March to April 2013. All households with 6 – 59 months old children from Hintalo Wajirat Woreda was the source population and all households with 6 – 59 months old children in the two kebeles of Hintalo Wajirat Woreda were source of study population. Households using irrigation for at least two years with children residing for at least six months; in the study area; and children in households without irrigation who also stayed for at least six months were

included in the study. Children with marked disability, and those who had injury were excluded due to inconvenience to take anthropometric measurements.

Sample size and sampling procedure: Sample size was determined based on double-population proportion formula. Wasting prevalence for irrigation users (3.8%) and for irrigation non-users (11.4%) taken from a study finding in Senegal (Simondon and Benefice 2000), 10% non-response rate, Design effect of 2, 80% power and 95% confidence level were used for sample size calculation. The total sample size was accordingly determined to be 836 (418 from irrigation user and 418 for irrigation non-user households). A stratified multistage sampling technique was employed to select the households. In the first stage, Hintalo-Wajirat Woreda was purposively selected from the eight woredas of South Eastern Zone of Tigray because this was the Woreda where it was possible to get enough sample size in two kebeles with similar agro-ecological characteristics. In the second stage, two kebeles from five kebeles, Waza Adiawena from irrigation user and May Nebri from the irrigation non-users were purposively selected. In the third stage, households were selected using computer generated random numbers after a census was conducted to list the total number of households with 6 – 59 months old children from both study kebeles. When more than one child was found in a given household, one child was selected randomly.

Data collection and analysis: Necessary information was collected using face to face interview from mothers and anthropometric measurements were taken from participant children. Anthropometric measurements of children were entered in to ENA-SMART software. After nutritional analysis, the anthropometric data from ENA-SMART software were transferred to excel and later on to SPSS version 20 for further statistical analyses. The data collected using questionnaires were entered and analyzed using the SPSS software. Descriptive statistics were provided for the socio-demographic status, agricultural status and participant children status. Bivariate analyses were employed using logistic regression models. Multivariable logistic regression was used to control for potential confounders and to observe the independent effect of explanatory variables on the dependent variables. All variables having p value less than 0.2 in the crude odds ratio were considered as important factors and used in multivariable analysis. After multivariable analyses were applied, the variables having p value less than 0.05 were considered as significant factors. The crude and adjusted odds ratios were mentioned together with their 95% confidence intervals (CI). Ethical approval to conduct the investigation was obtained from Mekelle University.

Results

Socio-demographic and agricultural characteristics: The total response rates for users and non-users were

95.6% (400) and 96.1% (402), respectively. Similar percentage of children (68%) was found in the age group of 24-59 months in both irrigation user and non-user households. The mean age of the mothers was 30.45 ± 7.203 years and 30.6 ± 6.914 years among irrigation users and non-users, respectively. The average land holding of the households was about half hectare in both groups. The median time elapsed to reach the

irrigation land on foot was 0.40(0.30-0.60) minutes from home. The main source of water for irrigation in most of the irrigation user households was stream water. Teff was the frequently cultivated crop in both communities. About 113(28.2%) of the non-user households and 163(40.8%) of the user households produced fruits and vegetables (Table1).

Table 1: Socio-demographic and agricultural characteristics of the irrigation user and non-user households from Hintalo Wajirat, South East Tigray, Ethiopia, 2013

Variable	Irrigation user		Irrigation non user	
	Frequency	Percent	Frequency	Percent
Age of the child				
6-23	128	32.0	127	31.6
24-59	272	68.0	275	68.4
Educational status of the mother				
Can't read and write	306	76.5	344	85.6
Can write and read	27	6.8	20	5.0
1-6 grade	37	9.2	22	5.5
Grade 7 and above	30	7.5	16	4.0
Educational status of the father				
Can't read and write	210	53.6	234	58.6
Can write and read	90	23.0	78	19.5
1-6 grade	54	13.8	63	15.8
Grade 7 and above	38	9.7	24	6.0
Agricultural land owning				
Yes	395	98.8	368	91.5
No	5	1.2	28	7.0
Don't know	0	0.0	6	1.5
Total land the house hold have				
<=2 timad	106	27.9	144	40.2
2.01-4 timad	149	39.2	140	39.1
4.01-6 timad	70	18.4	58	16.2
>= 6.01 timad	55	14.5	16	4.5
Irrigation water source				
under ground	5	1.2	-	-
stream water	390	97.5		
collected water	5	1.2		
Teff production				
Yes	399	99.8	397	99.5
No	1	0.2	2	0.5
Potato production etc...				
Yes	113	28.2	0	0.0
No	287	71.8	399	100.0
Producing green vegetables				
Yes	129	32.2	1	0.3
No	271	67.8	398	99.7
Fruits and other vegetables				
Yes	163	40.8	0	0.0
No	237	59.2	402	100.0
Do you produce legumes				
Yes	240	60.0	130	32.6
No	160	40.0	269	67.4
Time to fetch drinking water				
<=30 min	220	55.0	135	33.6
031-59 min	92	23.0	58	14.4
>=1.01hr	88	22.0	209	51.9

Hygiene and sanitation characteristics: The source of drinking water for 271(67.8%) irrigation users and 315(78.4%) non-users was well protected. The practice of treating water in home before drinking was 271(67.8%) in users and 231 (57.5%) in non-user

households. Utilization of latrine facilities was low as most of the households (60% each) had no toilet facilities. About 112(27.9%) from irrigation non-users and 21(5.2%) from the irrigation users disposed their wastes on the open field next door (Table 2).

Table 2: Hygiene and sanitation characteristics of irrigation user and non-user households from Hitalo Wajirat, South East Tigray, Ethiopia, 2013

Variable	Irrigation users		Irrigation non users	
	Frequency	Percent	Frequency	Percent
Water source of households for drinking				
River	118	29.5	74	18.4
Protected well	271	67.8	315	78.4
Others	11	2.8	13	3.2
Treating water in home before drinking				
Yes	271	67.8	231	57.5
No	63	15.8	157	39.1
Some times	62	15.5	14	3.5
I don't know	4	1.0	0	0
Having toilet				
Yes	163	40.8	159	39.6
No	237	59.2	243	60.4
Type of toilet				
Flush / pour flush toilet	37	9.2	31	7.7
Pit latrine with slab	121	30.2	3	.7
No facilities or bush or field	237	59.2	239	59.5
Others	5	1.2	129	32.1
Disposal system of house hold waste				
Buried	178	44.3	189	47.0
Dumped in street/open space	21	5.2	112	27.9
Disposed on farm	199	49.5	93	23.1
Other	2	0.5	8	2.0

Nutritional characteristics of the studied children:

The prevalence of stunting, underweight and wasting among irrigation users was 56.8%, 34.0% and 6.5% while among irrigation non-users were 68.2%, 43.8% and 14.4% respectively. More than 95% of the children from both groups were reported to complete their vaccination. Child sickness was reported among 126(31.5%) user and 70(17.4%) non-user households. Initiation of breast feeding immediately after delivery was less practiced among irrigation users (74.8%) than non-users (94.0%). Exclusive breast feeding was practiced in 282(71.2%) irrigation users and 280(70.4%) non-user households. There were 134(71.3%) and 69(35.8%) mothers from the irrigation user and non-user households who breast fed for more than 24 months, respectively. Complementary foods prepared from cereals other than teff was given to 231(57.8%) children in users, and 350(87.1%) non-users. About 91(22.8%) and 114(28.5%) households from the user households were feeding potato, other tubers, and any green vegetables. Feeding foods of animal origin, specifically milk and milk products, was more practiced in the non-user (69.2%) as compared to user households (61.8%).

i. Stunting in irrigation users and non users

In irrigation users: Consumption of milk in the last 24 hours, time spent to fetch drinking water and consumption of potato and other tubers were found to be independent risk factors for stunting in children. Mother who spent 31-59 minutes (AOR 1.854, 95%CI: 1.058, 3.249) and ≥ 60 minutes (AOR 2.549, 95%CI:

1.458, 4.455) in fetching drinking water had stunted children as compared to mothers who spent ≤ 30 minutes to fetch drinking water for household consumption. Children who did not consume potato and other tubers in the last 24 hours preceding to the survey were more likely to get stunted (AOR 1.692, 95%CI: 1.010, 2.836) compared to those who consumed. Similarly, children who did not take milk and milk products in the last 24 hours preceding to the survey were more likely to get stunted (AOR 1.711, 95%CI: 1.029, 2.845) compared to children who utilized (Table

In irrigation non-users: Consumption of milk in the last 24 hours, time spent to fetch drinking water; availability of cows, perceived birth weight and educational status of the mother were independent risk factors for stunting in children. Mothers who travel ≥ 60 minutes to fetch drinking water for household consumption (AOR 2.452, 95%CI: 1.446, 4.157) had more stunted children as compared to children of mothers who travel ≤ 30 minutes. Children who failed to consume milk in the last 24 hours preceding the survey were more likely to be stunted (AOR 1.957, 95%CI: 1.079, 3.549) compared to children who consumed milk. Children living in households who do not own cow (AOR 2.895, 95%CI: 1.280, 6.549) are more likely to be stunted as compared to children in households owning cow. Children from mothers who can't read and write primary level education were more likely to be stunted (AOR 3.806, 95%CI: 1.264, 11.461) than children from mothers with grade seven and above level of education (Table 3).

Table 3: Factors associated with stunting children in irrigation users and non-user households from Hintalo Wajirat, South East Tigray, Ethiopia, 2013

Variables	Irrigation users		Irrigation non-users	
	COR(95%CI)	AOR(95%CI)	COR(95%CI)	AOR(95%CI)
Potato and root food production				
Yes	1	1	-	-
No	0.602 (0.383, 0.946) *	0.627(0.376, 1.047)	-	-
24hr milk and milk product taking				
Yes	1	1	1	1
No	1.783(1.176, 2.703) **	1.711(1.029, 2.845)*	2.66(1.595, 4.455)***	2.065(1.14, 3.74)*
Drinking water fetching time				
≤ 30 minute	1	1	1	1
31 minute-59minute	2.391(1.436, 3.982)***	1.854(1.058, 3.249)*	1.196(0.636, 2.247)	1.351(0.689, 2.649)
≥ 1hour	2.915(1.710, 4.971)***	2.549(1.458, 4.455)***	2.386(1.494, 3.810)***	2.535(1.502, 4.279)***
24hrs potato and root foods				
Yes	1	1	1	-
No	1.741(1.087, 2.787) *	1.692(1.010, 2.836) *	1.176(0.425, 3.253)	-
Legumes production				
Yes	1	1	1	1
No	0.606(0.405,0.909) **	0.728(0.460, 1.150)	1.481(0.952, 2.304)	0.755(0.443, 1.288)
Educational level of father				
Can't read and write	0.999(0.499, 2.0)		- 1.925(0.827, 4.479)	2.136(0.831, 5.485)
Can read and write	1.333(0.618, 2.875)		- 2.391(0.937, 6.101)	3.163(1.11, 9.012)*
1-6 grade	1.091(0.473, 2.519)		- 3.846(1.406, 10.52)*	3.806(1.264,11.461)*
Grade 7 and above	1	1	1	1

ii. Underweight in irrigation users and non users

Irrigation users: Distance from irrigation land, consumption of milk in the last 24 hours, and consumption of potato and other tubers were the independent risk factors for underweight in children. Children from families who walked for more than an hour to reach their irrigable land were more likely to be underweight (AOR 2.643, 95%CI: 1.148, 6.084) compared to children from families who walked for less than 30 minutes (Table 4).

Irrigation non-users: Child age, consumption of milk, giving priority to selling of goods and availability of toilets were independent risk factors for underweight in children. Children who did not consume milk and milk

products in the last 24 hours prior to the data collection were underweight (AOR 2.301, 95%CI: 1.44, 3.677) compared to children who consumed milk and milk products. Children 6 – 23 months of age were more likely to be underweight (AOR 2.103, 95%CI: 1.326, 3.336) than 24-59 months old children. Children from families who were selling their agricultural products were more likely to be under weight (AOR 2.466, 95%CI: 1.430, 4.251) compared to children from families who were not primarily producing for selling their agricultural products. Absence of toilet (AOR 1.566, 95%CI: 1.001, 2.45) in the households was also an independent risk factor for underweight in children (Table 4).

Table 4: Factors associated with underweight in irrigation user and non-user households from Hintalo Wajirat, South East Tigray, Ethiopia, 2013.

Variables	Irrigation Users		Irrigation non-users	
	COR(95%CI)	AOR(95%CI)	COR(95%CI)	AOR(95%CI)
Time taken to reach irrigation site				
<30 min	1	10	-	-
30-45 min	1.4(0.753, 2.604)	1.404(.738, 2.674)	-	-
46min- 1hr	1.451(0.738, 2.854)	1.632(0.808, 3.293)	-	-
>1hr	2.657(1.200, 5.883)*	2.643(1.148, 6.084)*	-	-
Formula milk consumption				
Yes	-	-	1	1
No	-	-	2.604(1.086, 6.243) b*	2.569(1.034, 6.384)*
Legume and legume products use				
Yes	1	1	1	1
No	3.636(1.617, 8.179)**	3.033(1.307, 7.042)**	0.539(0.280, 1.039)	0.916(0.427, 1.962)
Consumption of cattle meat				
Yes	1	1	1	1
No	0.196(0.037, 1.022)	0.108(0.017, 0.697)*	0.223(0.123,0.404)	0.259(0.133, 0.501)***
Pre lacteal feeding				
Yes	1	-	1	1
No	1.212(0.542, 2.709)	-	0.290(0.121, 0.696)	0.345(0.137, 0.868)*

P≤0.05=*, p≤0.01=**, p≤0.001=***

iii. Wasting in irrigation users and non users

Irrigation users: Children who failed to consume legume and legume products were more likely to develop wasting (AOR 3.033, 95%CI: 1.307, 7.042) than children who had consumed legumes and legume products 24 hours prior to the survey. Children 24-59 months of age were less likely to get wasted (AOR 0.248, 95%CI: 0.104, 0.591) than children aged 6-23 months. Moreover, children who did not consume meat in the last 24 hours prior to the data collection were less likely to get wasted than (AOR 0.108, 95%CI: 0.017, 0.697) children who consumed meat in the last 24 hours prior to the survey (Table 5).

Irrigation non-users: Feeding of meat in the last 24 hours, possession of oxen by the household, availability of toilet, pre lacteal feeding within three days were the independent risk factors of wasting in children. Children who did not consume meat in the last 24 hours prior to the data collection were less likely to get wasted (AOR 0.259, 95%CI: 0.133, 0.5) than children who consumed meat in the last 24 hours prior to the survey. Possession of oxen by a given household (AOR 2.279, 95%CI: 1.153, 4.505) and avoidance of pre lacteal feeding within three days after delivery (AOR 0.345, 95%CI: 0.137, 0.868) were protective against child wasting (Table 5).

Table 5: Factors associated with wasting in irrigation users and non-user households from Hintalo Wajirat, South East Tigray, Ethiopia, 2013.

Variables	Irrigation users		Irrigation non-users	
	COR(95%CI)	AOR(95%CI)	COR(95%CI)	AOR(95%CI)
Legume consumption in the last 24 hours				
Yes	1	1	1	1
No	3.636(1.617, 8.179)**	3.033(1.307, 7.042)**	0.539(0.280, 1.039)	0.916(0.427, 1.962)
Cattle meat consumption in the last 24 hours				
Yes	1	1	1	1
No	0.196(0.037, 1.022)	0.108(0.017, 0.697)*	0.223(0.123, 0.404)	0.259(0.133, 0.501)***
Having oxen				
Yes	1	1	1	1
No	1.016(0.370, 2.787)	1.213(0.416, 3.535)	1.623(0.870, 3.027)	2.279(1.153, 4.505)*
Having toilet				
Yes	1	1	1	1
No	0.568(0.255, 1.261)	0.830(0.349, 1.974)	2.290(1.210, 4.336)*	1.254(0.613, 2.562)
Pre lacteal feeding within 03 days after delivery				
Yes	1	-	1	1
No	1.212(0.542, 2.709)	-	0.290(0.121, 0.696)	0.345(0.137, 0.868)*
Age of the child				
6-23 months	1	1	1	1
24-59	0.267(0.118, 0.607)**	0.248(0.104, 0.591)**	0.605(0.342, 1.072)	0.54(0.293, 0.994)*

$P \leq 0.05 = *$, $p \leq 0.01 = **$, $p \leq 0.001 = ***$

Discussions

This study finding revealed high prevalence of wasting (acute malnutrition) and stunting (chronic malnutrition) of children in irrigation user and non-user households. Regardless of the continued progress in reducing under nutrition in Ethiopia, child under nutrition is still a major public health problem in the irrigation user and non-user households. Although the prevalence of under nutrition was significantly better in irrigation user than irrigation non-user, still the figures are high. This high prevalence of under nutrition in both groups could be attributed to less agricultural land and poor cultivation method (Veronicah et al. 2007; Fentaw et al. 2013). The stunting rate in children from irrigation users and non-users were higher than the regional and national prevalence and the prevalence from South-West Ethiopia (CSA 2012; Deribew et al. 2010). The prevalence of underweight in children from irrigation users (34.0%) was similar to the regional prevalence reported in the EDHS 2011 (CSA 2012) and the report from Afar region (Fentaw et al. 2013). However, the prevalence of underweight in children from irrigation non-users was higher than that reported in EDHS 2011 (CSA 2012). Wasting in children from irrigation users (6.5%) was lower than the rate

reported in the EDHS 2011 (10.3%), from Afar communities (12.8%) and North Wollo Zone of Amhara region (9.0%) (CSA 2012; Fentaw et al. 2013; Haidar et al. 2005). In contrast, the prevalence of wasting in irrigation non-users was higher than that reported from Afar region and EDHS 2011 survey (CSA 2012; Fentaw et al. 2013; Haidar et al. 2005). Higher prevalence of stunting, underweight and wasting were found in children from irrigation non-users than irrigation users.

Similar findings were reported from Kenya, where children living in irrigation project had lower under nutrition than those living in non-project communities (Veronicah et al. 2007). The low prevalence of stunting, underweight, and wasting in children from irrigation user households could be due to the diverse dietary sources from irrigation for household consumption and additional income that might be generated from the selling of the agricultural and horticultural products while most of irrigation users were transporting water to irrigational land without monetary expense (Torlesse et al. 2003; Girard et al. 2012). This study finding revealed statistically significant association of stunting in children from irrigation user and non-user households with maternal time spent for fetching drinking water for household consumption.

Longer hours of travel by mothers for fetching water might have negative effect on their children's nutritional status by reducing their ' timely access to breastfeeding, household and personal hygiene, timely frequency of complementary feeding, food preparation time and income generating activities (Carvalhoes and Benício 2002 ; Jain and Choudhry 1993). A study from Ghana reported that women who spent more time to fetch drinking water for household consumption were not able to prepare foods timely and look after their children properly (Rathavuth 2006).

Distance to the irrigation land was found to be a factor influencing child nutritional status. Children from irrigation user households who had to walk for more than an hour were more likely to be underweight compared to those who used to walk for less than 30 minutes. Regardless of the importance of irrigation in improving the nutritional status of children, mothers far from their irrigable land might not have easy access to the agricultural products for household consumption and might deprive the children from maternal caring practices as the mothers might not return home in due time for child care and feeding practices once they left to the field for agricultural activities in the irrigation sites (Rathavuth 2006; Lü et al. 1999).

The findings indicated that child age was a predictor of wasting and underweight in children from irrigation user and non-user households. Older children (24-59 months) were less likely to be wasted in irrigation users and non-users compared to 6-23 months children. Similarly, younger children (6-23 months) were 2.1 times at risk of underweight compared to older children from irrigation non-user households. Similar observations have been reported from Egypt in which under nutrition begins around five months after birth and continues with an almost linear trend until the age of 15 months, which afterwards gets constant or considerably reduced (Khatab 2010).

Congruent with the present finding, previous reports indicate that children in the early ages (up to 18 months) are specifically vulnerable to decline in nutritional status (Odunayo and Oyewole 2006; Camilla et al. 2008). Contrary to these study findings, a study from Kenya reported that children in their second year of life were more likely to be underweight and stunted (Bloss et al. 2004). One possible explanation for the high prevalence of wasting and underweight in children from both irrigation user and non-user households at 6-24 months of age is the need for higher nutrient requirements for growth and development and due to limited energy reserves than other age groups (Picot et al. 2012). Less paternal education was associated with increased risk of stunting in irrigation non-user households. In agreement with this study finding,

Ugandan children of poorly educated parents (either mother or father) had increased risk of stunting (Joyce et al. 1998). Similarly, children of parents with no formal education were more vulnerable to malnutrition than children from literate parents (Fentaw et al. 2013). Improved knowledge and literacy of fathers was greatly associated with successful improvement in the nutritional status of children from Nairobi, Kenya (Abuya et al. 2012).

Availability of household latrine was also identified as a factor influencing underweight of children from the irrigation non-user households. Children from irrigation non-user households without toilet were found to be at an increased risk of underweight. Follow up study from Butajira, Ethiopia, also indicated that children from households without toilet facility were at increased risks of underweight and stunting (Medhin et al. 2010). Inadequate hygiene facilities increased the likelihood of chronic under nutrition in three consecutive studies conducted in Kenya (Masibo and Makoka 2012)..

The present study results also revealed that children who did not take milk and milk products within the past 24 hours had higher risk of stunting in irrigation users and non-users households. Similarly, children who did not consume milk and milk products during the previous 24hours had also manifested higher underweight in irrigation user households and non-user households. Similar with the present study finding, cow milk consumption is more likely to improve growth and thereby reduce morbidity and child under nutrition (Mølgaard and Michaelsen 2006; Allen and Dror 2011). Moreover, consumption of meat in the last 24 hours preceding the data collection put children at an increased risk of wasting in children from irrigation user and non-user households.

Failure to take legumes and legume products in the last 24 hours prior to the data collection was strongly associated with wasting in children from irrigation user households. Lack of consumption of potato and tuber foods in the last 24 hours prior to the data collection was 1.7 and 2.2 times more likely of stunting and underweight in irrigation user households, respectively. Potato and legume production could have positive impact in reducing children under nutrition when it is combined with good infant and young child feeding practices as evidenced by the results from the integrated agriculture and nutrition intervention (Orozco et al. 2007).

Selling of agricultural products had negatively affected the nutritional status of children from irrigation non-user households. Households giving priority to sell their agricultural products were associated with increased risk of underweight of irrigation non-users' children.

This could be attributed to insufficient production and selling of agricultural products. Households may sell high nutrient quality foods they produce and use that money to purchase micronutrient and protein poor staples for their consumption (Kandala et al. 2011; Girard et al. 2012).

The practice of giving any kind of pre lacteal feeding was found to be a risk factor for wasting in children from irrigation non-user households. The present study findings were in agreement with the study done in another part of Ethiopia where the use of pre lacteal feeding was reported to predict child under nutrition (Mulugeta et al. 2010). This is because the type and duration of pre lacteal feeding could negatively influence the "coming in" of breast milk (Pérez-Escamilla et al. 1996).

Children who were not feed cow's milk were also found 2.7 times at higher risk of stunting. In some studies, increased livestock holding of households was associated with decreased stunting, underweight and wasting of their children (Abuya et al. 2012; Haidar et al. 2005). Lack of cows could predispose households to lack of cow's milk product easily availability at home, consumption of milk, additional financial support they can generate by selling the milk and its products, and using the monetary income to purchase other valuable foods (Carlo and Dominique 2011; Rina et al. 2013). Oxen availability in a given household was also associated with decreased wasting in children from irrigation non-user households. The present study findings were in agreement with several study reports (Fentaw et al. 2013; Haidar et al. 2005). The role of oxen in improving nutritional status of children is evident as households with at least one pair of oxen would be able to prepare and plough agricultural land timely and appropriately (Singh et al. 2006)

Conclusions

Malnutrition remains to be a major public health problem among 6-59 age children in irrigation user and non-user households. The overall prevalence of stunting, underweight and wasting of children from irrigation users was 56.8%, 34.0% and 6.5% while among irrigation non-users was 68.2%, 43.8% and 14.4%, respectively. Stunting, underweight, and wasting prevalence were therefore lower in children from irrigation user households as compared to children from irrigation non-user households.

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