Socio-Economic Determinants of Nutritional Status of Children in Ethiopia

Anware Mohammed Ali, Muhdin Muhammedhussen Batu, Krishan Kanta Kaushik

Department of economics, Jimma University, Ethiopia

Abstract- This study aimed to assess the nutritional status and associated factors of children age five years and below in Ethiopia. The study was based on the secondary data obtained from Ethiopia demographic and health survey database, collected in 2011. A total of 9622 of children aged five years and below which contain the necessary information were considered in this study, analysed within a theoretical framework based on a health production function. A multilevel binary logistic regression model with random-intercepts was used for estimating the determinants of child nutritional status. The empirical results revealed that children from households in Tigray, Affar and Amhara regions were less-nourished. Level of education of parents, possession of media infrastructure (TV and radio), assets of household, contraceptive adoption and the condition of sanitation and water were considered to be important determinants of nutritional status of children. The pattern of growth-faltering in children by age was identified. Children aged 13-59 months were less-nourished than those aged 0-12 months. In addition to analyzing nutritional status for the whole sample, we have also separately analyzed for urban and rural households, and found that the determinants differed. Finally, based on the results of the study, the paper proposes several policies aimed at improving the delivery of nutrition to more effectively address the problem of under-nutrition.

Index Terms- Underweighting, Stunting, Wasting, under-nutrition

I. BACKGROUND AND JUSTIFICATIONS OF THE STUDY

In an agriculturally oriented country like Ethiopia, the concept of food security is often confused with nutritional status. Household food security is concerned with the regularity of household calorie availability, whether derived from the household's own production or from household purchasing power. Household nutritional status, on the other hand, refers to the nutritional status of its individual members, which in turn results from a combination of nutrient intake, physical output, and disease. Nutritional status of preschool children is used as a proxy for the family's nutritional well-being. This convention is adopted for two reasons. First, preschool children, along with pregnant or lactating women, show nutritional stress earlier than other household members (Martorel, 1982). Second, international reference standards exist for evaluating the nutritional status of preschool children, thus permitting comparisons over time and across countries.

In other way, the two confusing terms malnutrition and undernutrition are different. Malnutrition refers to deficiencies, excesses or imbalances in intake of energy, protein and/or other nutrients. Contrary to common usage, the term 'malnutrition' correctly includes both undernutrition and over-nutrition. Under-nutrition is the result of food intake that is continuously insufficient to meet dietary energy requirements, poor absorption and/or poor biological use of nutrients consumed, where our study is concerned. Over-nutrition refers to a chronic condition where intake of food is in excess of dietary energy requirements, resulting in overweight and/or obesity (WHO, 2005).

Globally, undernutrition in children is highly prevalent and remains a big challenge. According to United Nations Food and Agriculture Organization (FAO) estimates, 11.11% of world populations were suffering from chronic undernourishment in 2012-2014 (FAO, 2014). Beyond all, children are the most visible victims of undernutrition. According to United Nations Children's Fund (UNICEF) report, 25% and 8% of under-five year old children were estimated to be stunted and wasted respectively and an estimated 6·3 million live born children worldwide died before age 5 years, in 2013 because of undernutrition (UNICEF et al., 2014b). This shows that nearly half of all deaths in children under 5 are attributable to under nutrition.

Similarly, in Ethiopia About 33.6 percent of the Ethiopian population are living below the food poverty line and cannot meet their daily minimum nutritional requirement of 2200 calories (MOFED, 2013). Based on recent survey of Ethiopian demographic and health survey (DHS) mini report, nationally 40%, 25% and 9% of children under age five were stunted, underweight and wasted respectively in 2014 (CSA, 2014). But according to this report the prevalence of overweight or obese children was not more than 3%. This high prevalence of under-nutrition of children exerts negative social and economic impacts. For example, 28% percent of child deaths are associated with under-nutrition; 44% of the health costs associated with undernutrition occurs before the child turns 1 year-old; Undernutrition is estimated at 55.5 billion Ethiopian birr, which is equivalent to 16.5% of GDP during the period 2004 to 2009 (African Union Commission et al., 2014). As figures showed, in Ethiopia over nutrition is not much problem like under-nutrition; due to this fact our study is only focus on factors affecting under-nutrition of children.

The condition of nutrition in Ethiopia thus, remains to be a grave issue for policy-makers to consider and a compelling area of study for research aimed at its alleviation. Even though the problem of child malnutrition in Ethiopia has been sufficiently documented, the reasons behind it are still poorly understood. The researcher shares the idea and the main reason behind the need to study socio-economic determinants and differentials of

nutritional status in Ethiopia is, so far, there are not money detailed studies conducted to explore socio-economic aspects of nutritional status in Ethiopia. While most studies on health and nutrition of both children and adults look into the effects of nutrient consumption and food availability, few studies focus on the relationship between nutritional status and non-nutritional factors, like educational attainment, availability of water and sanitation, etc. And among these already few studies that look into socioeconomic aspects, fewer still give emphasis to children's nutritional status. The studies done in country level (Girma et al., 2002; Alemu et al., 2011) ignore community and household heterogeneity effect on child undernutrition and they simply used logistic regression and linear model instead of multilevel logistic regression or multilevel linear mixed model.
This study, therefore, aimed at examining the relationship between the socioeconomic factors and the nutritional status of children and also aimed at using the findings as the basis for policy recommendations on nutrition interventions in Ethiopia by using multilevel logistic regression model.

II. LITERATURE REVIEW: SOCIO-ECONOMIC DETERMINANTS OF NUTRITIONAL STATUS OF CHILDREN

Various studies in different/same countries may find different results over the importance of the determinant factors behind children's nutrition. Estimates may differ depending on various factors including the nature of the data and estimating methodology. Most available studies concerned with the socioeconomic determinants of child health emphasize the effects on health of several constraints such as parental knowledge, physical resources, and government programs, along with nutritional intake. These studies were conducted in a variety of methods that range from simple analysis of descriptive statistics to more mathematical methods like reduced form equation estimation. Throughout the years, more sophisticated models and larger data sets were employed in order to better probe the causes of child malnutrition. Worth mentioning are the studies which analyzed data from developing countries, since determinants such as income and government programs bear greater importance in poorer countries than in developed ones (Behrman and Deolalikar 1987; Duflo 2000cited by Michael DA. and Ralph MM.(2003)).

The economic status of a household where a child lives has been identified as one of the key determinants of child nutritional status. Using data from four regions of Brazil, Thomas et al. (1990b) attempted to estimate the impact of household characteristics on child height and survival. Applying the quasi-maximum likelihood estimation techniques for the binomial model and instrumenting income by logarithm of household expenditure and including unearned income, its square and a set of month dummies, income appears to have no effect on child height in all four of the regions. Consistently, as food availability is one of household resources, both Alderman (1990) and Maxwell et al. (2000) in Ghana did not found it to be a significant factor; rather care and health were find to be important inputs. Moreover, Maxwell et al. (2000) did not find higher incomes leading to significantly improved care practices and behaviors. These studies contradicts the World Bank argument that malnutrition is a manifestation of poverty, i.e. that an increase in income will increase expenditure on food, and subsequently the child's intake of nutrients. After estimating the reduced form food and nutrient relations, they did not reject the null hypothesis that elasticity was equal to zero, i.e. there was no significant change in food intake after an increase in income: the subject households tend to devote the increase in income to concerns other than food quantity. The paper therefore, highlights the importance of factors other than income that mediate the production of health, and stresses the need for education on health production and nutrient intake to accompany any such direct interventions on income.

But in Ethiopia, most of the studies including Christiaensen and Alderman (2001); SCUK (2002), Woldemariam and Timotewos (2002); Yimer (2000); Tesfaye (2009); Bilisuma (2004); Alemu et al. (2011); Abay Asfaw (1995), and Silva (2005) has found household wealth/income as an important determinant of child nutritional/health status. According to SCUK (2002), for example, better off households have better access to food and higher cash incomes than poor households, allowing them a better quality diet, better access to medical care and more money to spend on essential non-food items such as schooling, clothing and hygiene products. The studies mentioned above proxy wealth/income in either one or the other of the following variables: housing quality, cattle and land ownership/rental, households' access to food, cash income/expenditure etc.

Many studies were also intended to examine the relation between child health and parental characteristics. A study conducted by Kamiya (2011) in Lao used multilevel mixed linear model in order to estimate a health production function. The result showed that educational attainment of mothers did not exert any positive impact on childhood nutrition (height-for age, weight-for –age and weight-for height), contrary to numerous previous studies, when it was estimated together with education of fathers. But education of mother shows high in magnitude than father education and both are significant independently. Likewise, Michael DA. And Ralph MM. (2003) used an ordered probit regression yielding maximum likelihood estimates for the specified reduced form model of health. The results showed that years of schooling of parents have a significant impact on child nutritional status.

Another study that used a health production function was that of Glewwe (1999 cited by Michael DA. and Ralph MM.(2003)) which used evidence from Morocco and starts with the notion that mother's education is often found to be positively correlated with child health and nutrition in developing countries. As such, Glewwe proposed a health production function relating z-scores for child height-for-age to inputs such as father's schooling, mother's skills in literacy and numeracy, mother's health knowledge and household income. Using OLS, 2SLSand Community Fixed Effects (FE), and the author produced reduced form estimates of the determinants of child height and observed that mother's health knowledge is the most significant pathway through which mother's education raises child health. Similarly, Smith and Haddad (2000) on the title using logistic regression analysis showed that education of women has several positive effects on the quality of care rendered to children in developing countries since women are the main care takers of children.

In Ethiopia, few researches have been conducted based on health production function. For example, using household data from three consecutive welfare monitoring surveys of Ethiopia over the period 1996-1998, Christiaensen and Alderman (2001) found that both female and male adult (parental) education has a strong positive and statistically significant effect on the child's nutritional status, and the effect of female education is about twice as large as that of male education. This study also shows that maternal nutritional knowledge is key determinants of chronic child malnutrition in Ethiopia. The study used linear regression analysis to estimates health production function. Other studies also report similar results from female's education (Dejen, 2008; Woldemariam and Timotiows, 2002; Alemu et al., 2005b; Silva, 2005). For example, using district level data on children under age of 24 months, SCUK (2002) confirmed that children whose mothers attended school were less likely to be malnourished than the children of uneducated mothers. But the listed authors haven't used health production function and they simply estimate the socio-economic determinants with other factors together except SCUK (2002).

Different literatures also showed that health access and health variables have significant impact on child malnutrition status. Kamiya (2011) in Lao showed that distance to health services, coverage of vitamin A supplementation and the bednet was associated with weight-for-age. All the variables reflecting sanitation and water, the prevalence of childhood diarrhea had a negative impact on height-for-age, the latrine coverage positively correlated with height-for-age, and households' average time to get water had negative impacts on weight-for-age and weight-for-height. Kesitegile (1994) showed presence of latrine and sanitation has positive correlation with child underweighting in Bostwana by using logistic regression analysis. Girma et al. (2002); Alemu et al. (2011) used logistic regression for urban and rural Ethiopia separately and showed presence of diarrhea, toilet access and water safety have a significant correlation with child stunting. Sex difference in nutrition was also observed from previous surveys and research findings. A number of studies in regions of Africa for example, MoFED, 2013; Sahn Stifel, 2003; Christiaensen and Alderman, 2001, suggest that rates of malnutrition among boys are consistently higher than among girls.

Household size is also important in the analysis of child nutritional and health status for it has direct implications on household resources. Senauer and Garcia (1991) using household survey data Philippines found that household size have a significant positive impact on height of children. The authors argue that this could be because household full income is a function of wage rates and the number of economically active family members, and thus, this variable may be reflecting a full income effect. The author used linear regression model in order to estimate the health production function.

In general, previous studies found that interventions which seek to alter single factors in the environment, such as food intake alone or the health environment alone; bring about insignificant improvement in children's development or chances of survival as Payne (1992) was underlined. So that, with the existing complexity of methods being employed over the years in order to determine the causes of child malnutrition in developing countries, this paper sees it fit to follow after the recent studies on the determinants of child health by using anthropometric data, involving a range of socioeconomic variables like gender, household wealth index , parental education, environment endowments, presence of safe water and sanitation, health facilities, and finally, situating the analysis within the framework of a health production function.

III. METHODOLOGY OF THE STUDY

The dataset used for the study was from the Ethiopia DHS, collected in 201. It includes demographic, socioeconomic and health information from nationally representative sample in Ethiopia. The sample domains in 9 regions (Tigray, Afar, Amhara, Oromiya, Somali, Benishangul-Gumuz, Southern Nations Nationalities and peoples (SNNP), Gambela and Harari), and the two city administration areas (Addis Ababa and Dire Dawa). A representative probability sample of 14,645 households was selected for the 2011 Ethiopian DHS survey. The sample was selected in two stages. In the first stage, 540 clusters were selected from a list of enumeration areas from the 1994 Population Census. In the second stage, a complete listing of households was carried out in each selected cluster. Between 27 and 32 households from each cluster were then systematically selected for participation in the survey. Finally, 13,721 households comprising 67,556 members (including10481) were successfully interviewed. Because we are only interested nutritional status of children aged five and below, we only considered a total of 9622 out of 10481 children age 5 years and below which have the necessary full information for this study and those whose information didn't register properly were ignored from the analysis.

To estimate the determinants of nutritional status of children, the study applied a reduced form equation derived from the standard Beckerian household utility function of consumer demand (Becker, 1981) and Grossman's health production function (Grossman, 1972). Nutritional data collected as a part of the Demographic and Health survey program (DHS) are clustered at the community, and household level. The malnutrition risks of children from the same cluster tend to be more alike than the risk of children chosen at random from whole population. Thus, multilevel binary logistic regression model was particularly applied considering heterogeneities at both household and community levels (McCullagh, P. and Nelder, J., 1989)

This might result from the fact that the nutritional status of children born to the same community is not independent because of unobserved community characteristics, such as local climate, infectious diseases, and food availability, may affect children's nutrition. Similarly, children from the same family share similar genetic factors. Therefore, the usual assumptions of independence between event times may not be valid. As a result, analyses that fail to account for the associations of nutritional status are more likely to under estimate the variance of parameters.

In this study, a height and weight measurement of children, taking age into consideration, was converted into Z-scores based on the National Center for Health Statistics (NCHS) reference population recommended by the World Health Organization (WHO, 2002). Thus, those below -2 standard deviations of the NCHS median reference for height-for-age, weight-for-age and

weight-for-height are defined as stunted, underweighted, and wasted, respectively. All the three indicators are used to describe the level of child malnutrition/health problem.

The dependent variable is dichotomous and clustered at community and household level multilevel binary logistic regression with random effect is used to identify the socioeconomic and demographic determinants of nutritional status of children. We thus, employed an econometric analysis involving discrete choice variables, the possible outcomes being that the child is (1) undernourished (mildly, moderately or severely), (2) not under nourished (normal or over nourished). Consequently, the model was expressed as:

$$\log it(\pi_{ijk}) = \log\left(\frac{\pi(Y_{ijk}=1/X_{ijk})}{1-\pi(Y_{ijk}=1/X_{ijk})}\right) = \beta_0 + \beta_1 X_{ijk} + U_j + U_k,\ 0 \le \pi \le 1$$

Where $\pi(Y_{ijk}=1/X_{ijk})$ is the probability of child i born to mother j in community k is undernourished given child's characteristics X_{ijk}; U_j and U_k refers to an unobserved mother specific and community specific random effect; X_{ijk} is a vector of covariates at the child, household and community levels. $\beta \varepsilon R^k, \beta = (\beta_0, \beta_1, ..., \beta_k)^T$, β is a vector of unknown logistic regression coefficients.
Where:

Dependent Variable: Nutrition status is in a binary nature given as (undernutrition=1) or (not undernutrition=0) for the three measure of nutrition (stunted, underweighted, and wasted).

Independent variable, X_{ijk};
-Residence of households (residence), discrete variable.
-Region of residence(region), discrete variable.
-Religion of Households.
- Age of household head (Hhage), continues variable.
-Household size (hhsize), continues variable.
- Sex of household head (hhsex), discrete variable.
-Marital status (martst), discrete variable.
- Child sex discrete variable.
-Child age, discrete variable.
-Mothers' education level (edcnm), discrete variable.
- Father education (fthredcn), discrete variable.
- Household wealth status (wealth), discrete variable.
-Toilet access (toilet), discrete variable.
- Water status (water), discrete variable.
- Electric access (electric), discrete variable.
- Distance to health Services (disthlth), discrete variable.
- Health access (healthacce), discrete variable.
- Use contraceptive, discrete variable.
- Distance to health Services, discrete variables.
-Possession of recent diarrhea, discrete variables.
- Possession of recent fever, discrete variables.
-Possession of recent cough, discrete variables.
Totally, 21 variables were used as independent variable.

IV. DATA ANALYSIS AND DISCUSSION

a. Socio-Economic features of respondents

About 89% of households' heads were male, who were also typically the fathers of the children. Muslim households account 47.84% and orthodox, catholic and protestant accounts 31.52%, 0.94% and 19.70% respectively. Most (88.18%) of respondents were married. Out of the total respondents 83.99% were taken from rural part of Ethiopia and the remaining 16.11% were from urban areas. The sample were obtained from all 9 regions and 2 administrative cities of Ethiopia.

Table 1: Demographic Features of Respondent (n =9622).

Demographic features	In percentages
Marital Status	
Married	88.18%
Separated	11.82%
Religion	
Muslim	47.84%
Orthodox	31.52%
Protestant	19.70%
Others	0.94%
Sex of household head	
Male	81.94%
Female	18.06%
Region	
Amhara	11.07%
Harari	5.31%
Somali	7.91%
Benishangul-Gumuz	8.66%
Oromia	15.72%
SNNP	14.24%
Affar	9.43%
Addis Ababa	3.35%
Dire Dawa	6.10%
Tigray	11.16%
Gambela	7.14%
Residence	
Rural	84%
Urban	16%
Total	100%

Source: Ethiopian Demographic and Health survey database (CSA, 2011).

More than half of (51.63%) of the sampled children is taken from four regions i.e., Oromia (15.2%), Southern nation and nationalities (14.2%), Amhara (11.07%) and Tigre (11.16%). The minimum sample of children is taken from Addis Ababa (3.35%) and Harari (5.31%).

The average age of household and average family size is 37 years and 5.69 per household respectively. The mean ages of children were 29.48 with a range of 59 months.

Table 2: Summary of age and family size (n =9622).

Demographic Features	**Mean**
Age of household head	37
Family size per household	5.69
Ages of children in month	29.48±17.21

Source: Ethiopian Demographic and Health survey database (CSA, 2011).

The wealth index used in this survey is a measure that has been used in many DHS and other country level surveys. It serves as an indicator of level of wealth that is consistent with expenditure and income measures (Rutstein, 1999). Households were categorized based on their wealth index status. Around 34% of the total households were rich and the rest 49.36% and 16.56% of the households under study were categorized as poor and middle respectively.

Table 3: Household economic characteristics (n =9622).

Demographic Features	Mean
Age of household head	37
Family size per household	5.69
Ages of children in month	29.48±17.21

Source: Ethiopian Demographic and Health survey database (CSA, 2011).

Availability of safe source of drinking water, sanitation facilities, and electric power access and health services expected to influence children nutritional status. About 47.65%, of households had either a flush or pit latrine while 17.24% had a safe source of drinking water (which includes tap water and protected wells/ springs). About 17.24% of households had electric power access at their home. Distance to public health facilities was used as an indicator of access to public health. Almost one quarter (74.48 %) of the households said that distance from public health services were their big problem.

Table 4: Households access to sanitation and health abd other public services (n=9622).

Table 4: Household access to sanitation, health and other public services (n=9622.)

Variables	In Percentage
Toilet access	
Yes	47.65%
No	52.35%
Water status	
Safe	36.77%
Unsafe	63.23%
Electric access	
Yes	17.24%
No	82.76%
Distance to health	
Not big problem	25.51%
Big problem	74.49%
Health access	
Yes	0.47%
No	99.53%
Total	100%

Source: Ethiopian Demographic and Health survey database (CSA, 2011).

Ownership of radio and TV, which may be used as an indicator of access to communication infrastructure and may be expected to facilitate the acquisition of nutritional information and could influence the nutritional status of children. Only 37.05% which is less than half of the total households have radio access. Similarly, very few (9.32%) of the households had television.

Table 5: Households access to communication infrastructure (n=9622).

Variables	In Percentage
Radio access	
Yes	37.05
No	62.95%
Television access	
Yes	9.32%
No	90.68%
Total	100%

Source: Ethiopian Demographic and Health survey database (CSA, 2011).

Of the total sample 15.65% and 19.95% had diarrhea and fever in the two weeks period before the survey respectively. Similarly, 20.62 % of children had cough in the same period.

Table 6: Child recent health characteristics (n=9622).

Variables	Percentage
Had diarrhea recently	
Yes	15.65%
No	84.35%
Had fever recently	
Yes	19.95%
No	80.05%
Had cough recently	
Yes	20.62%
No	79.38%
Total	100%

Source: Ethiopian Demographic and Health survey database (CSA, 2011).

To assess the nutritional status of children, three anthropometric z-scores based on the World Health Organization/Centers for Disease Control and Prevention/National Center for Health Statistics references were used (WHO, 2002). Height-for-age z-score is a longer term index which represents linear growth of a child. It gives information about chronic undernutrition or 'stunting' which reflects the accumulation of past outcomes. Weight-for-age z-score is an index of both acute and chronic undernutrition which provides information about 'underweight'. Weight-for-height z-score is a shorter-time index which indicates acute undernutrition or 'wasting'. Wasting is usually caused by a recent nutritional

deficiency and may manifest significant seasonal variations according to changes in the availability of food or prevalence of disease. A child whose height-for-age, weight-for-age, or weight-for-height is more than 2 standard deviations below the median of the reference population is classified as moderately or severely stunted, underweight, and wasted respectively.

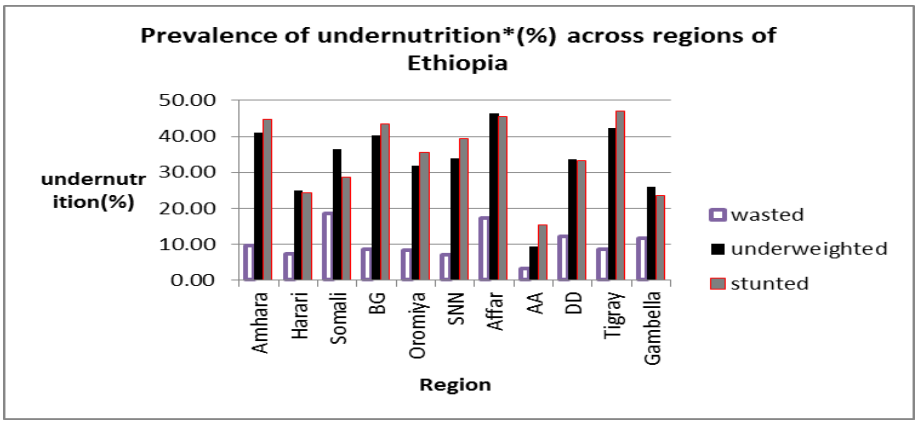
Table 7 and Figure 1 below show the prevalence of undernutrition among the sample children aged 0-59 months, measured by z-scores. There are large variations in childhood undernutrition across age-groups, child residence, and regions.

Table 7: Prevalence of undernutrition among children aged 0-59 months in Ethiopia.

Prevalence of undernutrition	Nutritional status		
	underweight	stunted	wasted
Sex of Child (%)			
Male	36.12	38.01	11.04
Female	34.44	36.01	9.29
Residence (%)			
Urban	20.26	21.23	7.21
Rural	38.21	40.04	10.75
Age (Months) (%)			
0-12	16.02	11.75	9.44
13-24	43.42	42.80	18.54
25-36	44.69	43.18	9.11
36-59	37.66	45.38	7.27
Total	35.34	37.03	10.18

There were no significant variations in childhood nutritional status between male and female children in all 3 measures. In all 3 cases the percentage of male children is slightly higher than percentage of undernutrition females. But, there were large variations across residence and child age. Most of rural children are more undernourished than urban children. Percent of underweight and stunted children in rural is almost two times urban children. The percentage of underweight children increased from 0-12 months of age up to 25-36 and then declined at 37-59 months of age. Percentage of stunted children was strictly increased with increased child age. In contrast, with increasing age of child, percentage of wasted children became decreased.

Figure 1 presents the percentage of undernutrition (underweight, stunted and wasted), across 9 regions and 2 administrative cities (DireDawa and Addis Ababa) of Ethiopia in 2011. It was confirmed that there was a large gap in the nutritional status of children between the best and the worst communities for each of the z-scores. For instance, the percent of underweight and stunting varied from 9.32% and 15.22% (Addis Ababa) in the best to 46.38% and 46.99% (in Affar and Tigray respectively) in the worst community. The wide variations of undernutrition among communities imply that there are large heterogeneities at the community level to affect the nutritional status of children.



Note: BG is Benishangul-Gumuz; SNN is southern Nations and Nationalities; AA is Addis Ababa, DD is Dire Dawa.* indicates it is based on WHO (2002) definition.

Figure 1: Prevalence of undernutrition among children aged 0-59 months across regions of Ethiopia, 2011.

a. Socio-economic determinants of nutritional status of children.

Nutritional status of children (underweight, stunting and wasting) was regressed against various explanatory variables, in order to identify determinants of nutritional status of children in Ethiopia. Before fitting the multivariable model we fitted first the bi-variable logistic regression. Accordingly, predictors which have a p-value greater than 20% were rejected from the multivariable model. After fitting the multivariable model we select a variable by using stepwise selection method and the final model goodness-of-fit checked through Hosmer and Lemeshow test (Hosmer, D. W. and Lemeshow, S., 1989) and it fits well.

Table 7 presents the odds ratio and p values for children aged 0-59 months for the three measure of nutritional status based on anthropometric z-scores. In the estimation, a multilevel logistic regression model with random-intercepts expressed in equation [1] was performed using Stata 12. As to the choice of model, the results of likelihood-ratio (LR) tests (χ^2: LR test Vs logistic regression) suggest that a multilevel logistic regression model with random-intercepts is preferable to an ordinary logistic regression model with fixed-intercept in the estimation for the 2measure of nutrition ($p \leq 0.001$ for underweight, stunting). But communities and household level heterogeneities were not significant for wasting. Because of this, there is no difference between multilevel logistic regression model with random-intercepts and an ordinary logistic regression model in estimation of factors of children wasting. Looking at the results of child's characteristics, there was no significant difference between male and female children to be underweight. But there was a significant difference for the child for being stunted and wasted. Being female has 9.13% and 16.05 % less risk to be stunted and wasted. As expected, the age of the child was significantly associated with undernutrition as measured by all the three cases. Children aged 13-59 months were much more undernourished than those aged less than 13 months ($p<0.01$).Noticeably, the size of an estimated odd ratio suggests that the odds of stunting kept rising throughout all the age-bracket until 36-59 months of age. In contrast, the odds of underweight increased up to 13-24 months and 24-35 months of age respectively and decreased thereafter. In other way, the odds of wasting increased up to 13-24 months and leveled off thereafter. Like in urban children rural children undernutrition is affected by child ages and the extent is high in rural than urban based on the separate rural and urban model estimates.

Though the bivariate analysis showed significant urban-rural differentials in under nutrition, this difference disappears in the multivariate model. This was the same as Girma et al. (2002) and Alemu et al. (2005). This result may happen because of that in the presence of important socioeconomic variables area of residence alone is not a predictor of nutritional status of children. However it should be noted that these socioeconomic variables are manifested differently in the urban and rural areas. In response of this, we fitted multivariable logistic regression model for urban and rural community separately. Children from Addis Ababa, Harari, Somali and Gambellawere less underweight and stunted than the reference (Amhara) region. Children from Somali, Affar and Dire Dawa had higher chance to be wasted than the reference population (Amhara region). Children from those regions have 2.0297, 1.848, and 1.5476 times risk to be wasted than children from Amhara region respectively. Based on our finding Tigray, Amhara and Benishangul-Gumuz regions show high risk of underweighting and stunting. The observed higher risk of undernutrition in Tigray, Amhara and Benishangul-Gumuz regions may be due to differences in economic levels, and cultural and dietary practices. Earlier surveys have also shown a very high prevalence of stunting in these regions (CSA, 1998; CSA, 2007). These regions were the peaked food poverty observed regions (MOFED, 2013). This result also agreed with the study done by Girma et al. (2002). Kamiya (2011) in Lao has found also a significant variation in nutritional status of children in central, northern and southern regions.

Educational attainments of mothers did not exert positive impact on childhood nutrition, when it was estimated together with education of fathers. It is inconsistent with the study done in Lao by Kamiya (2011).On the other hand, both primary and secondary schooling of fathers positively correlated with children's nutritional status in the three measurements. The insignificance of mother's educational effect might be caused by the correlation between education of mothers and education of fathers. To scrutinize this point, a correlation coefficient was first calculated between the categorical variables of education of mothers and education of fathers. Correlation was high for mother education and father education (0.255). By using stepwise model selection method schooling of father dropped from the model. Educational attainment of mothers had stronger and broader effect on children's nutrition. The odds of being underweighted and stunted reduced with better formal education of mothers. But it had insignificant and negative impact on child to be wasted. Kamiya (2011) in Lao showed that formal educations of mothers have impact on all three measures (underweight, stunting and wasting) unlike our result. Small-scale studies in Ethiopia have also shown the importance of maternal education to child nutrition (Kandala, et al. 2007; Khalid, 2006; Mohammed, 2008; Genebo et al., 1999; and Yimer, 2000). Studies done in the case of Ethiopian households by Alemu et al.(2012); Tesfaye(2009) and Sentayehu (1994) found that formal education of mothers did exert positive impact on childhood nutrition, when it was estimated together with education of fathers. When we fitted a separate model for urban and rural communities separately, fathers' formal education became more powerful predictor than mother education in rural communities of Ethiopia. So that in rural when father formal education is improved; it leads to improvement in nutritional status of children.

We also find that there a significant and negative association between wealth index and undernutrition (underweighting and wasting) at 5% level of significance and stunting at 10% level of significance. When we analyze the urban and rural communities separately, the association was significance for urban areas, but the association was insignificant in rural areas. This result coincides with the findings of Girma et al. (2002) and Alemu et al. (2011).This insignificancy may partly be because that nature of the wealth index we used for this study is more sensitive to urban wealth indicator than rural ones.

All the variables reflecting sanitation and water exerted the expected results. The prevalence of childhood diarrhoea had a negative impact on underweighting, stunting and wasting.

Latrine coverage negatively and significantly correlated with only underweighting. Toilet access has also a significant contribution for reduction of wasting at 10% level of significance. The odd of being stunted is higher for those households have no toilet service than have toilet even if the effect is insignificant at 5% and10% level of significance. Though the bivariate analysis showed a positive association between children stunting and the availability of safe drinking water, the significance of this variable disappear in the multivariate model. Since water and sanitation are not only environmental measures but may also be proxies for economic status, in the multivariate model there were more direct measures such as education and wealth index that may override these less precise measures which are in line with the findings of Alemu et al. (2011); Kandala et al.(2001) and Woldemariam & Timotiows (2002).Unlike our study Kamiya (2011) in Lao found that households' average time to get water had negative impacts on weight-for-age and weight-for-height. Possession of electric power has a significant and positive correlation with underweighting of children, which was the expected result. But it has insignificant contribution for reduction of underweighting of rural children, when we fitted a separate model. But it showed more pronounced estimates for urban children for estimation of underweighting.

The coverage of television, which represented the communication infrastructure providing information about child health improvement, was statistically significant for all 3 measures of nutritional status. The results also suggest that ownership of television has a significant negative effect on underweighting, stunting and wasting of children. The effect is also significant and negative for separate analysis of urban and rural children. This result is in contradiction with the study done by Alemu et al. (2011). Their result shows that ownership of television has positive effect on nutritional status of urban and opposite result for rural. This may happen because today households who use television in urban and rural are increased. For example in our sample 764 and 776 households in urban and rural own television, but in the previous research of Alemu etal. (2012) only one individual had television in rural. Our finding is also in contradiction with the study done by Kamiya (2011) in Lao. And possession of radio has a significant contribution in reduction of underweighting and stunting at 5% and 10% level of significance. But it has insignificant and negative correlation with wasting.

The variables representing the local health systems exhibited some complex results. Contrary to the expectation, the proportion of vaccinated children per community exhibited a significant positive impact on stunting. It might be caused by the opposite causality, i.e. children who were stunted were more likely to seek vaccination than non-stunted. The effect is positive in underweighting also even if the correlation is significance but positive and insignificance for

Table 7: Multilevel mixed effect logistic regression model estimates.

Variables	Underweight		Stunting		Wasting	
	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value
Child age						
0-12†						
13-24	4.8751	0.000	6.6136	0.000	2.2899	0.000
25-36	5.3474	0.000	6.8525	0.000	.96198	0.733
36-59	3.9153	0.000	7.5632	0.000	.81199	0.041
Child sex						
Female	.9296	0.136	.9087	0.047	.8395	0.014
No†						
Wealth index score						
Poor	1.2140	0.015	1.1457	0.081	1.2217	0.100
Middle	1.0584	0.510	1.0565	0.512	1.3074	0.040
Rich†						
Education of mother						
No education	4.1189	0.000	2.4447	0.002	1.3978	0.453
Primary	3.6413	0.000	2.2936	0.004	1.2651	0.598
Secondary	2.8435	0.009	1.9134	0.046	.8738	0.793
Higher†						
Residence						
Rural	1.0663	0.571	1.2352	0.054	.8988	0.495
Urban†						
Contraceptive use						
No	1.2488	0.000	1.2126	0.001	1.0900	0.345
Yes†						
Electric access						

No	1.3210	0.019	1.1703	0.168	1.0699	.7569
Yes†						
Presence of fever						
No	.7197	0.000	.8800	0.049	.7031	0.000
Yes†						
Presence of diarrhea						
No	.6232	0.000	.7217	0.000	.6519	0.000
Yes†						
Child vaccination						
No	.9359	0.189	.8726	0.006	1.0598	0.421
Yes†						
Possession of toilet						
No	1.144	0.028	1.0381	0.533	1.1909	0.058
Yes†						
Possession of Radio						
No	1.1262	0.035	1.1104	0.057	1.1210	0.164
Yes†						
Possession of TV						
No	1.8712	0.000	2.1148	0.000	1.8232	0.008
Yes†						
Region						
Harari	.7314	0.033	.56977	0.000	1.0015	0.995
Somali	.7402	0.015	.45133	0.000	2.0297	0.000
Benishangul-Gumuz	.9546	0.683	.9854	0.893	.8300	0.280
Oromia	.7315	0.002	.7408	0.002	.9327	0.641
SNNP	.76698	0.009	.8249	0.049	.7488	0.067
Affar	1.0840	0.491	.9739	0.815	1.8483	0.000
Addis Ababa	.4863	0.003	.7295	0.127	.7177	0.376
Dire Dawa	.9325	0.603	.7924	0.075	1.5476	0.017
Tigray	1.1597	0.164	1.1630	0.139	.9254	0.629
Gambela	.4051	0.000	.3226	0.000	1.0710	0.697
Amhara†						
Constant	.0269	0.000	.02648	0.000	.0483	0.000
Wald χ^2 (28)	634.31	0.000	724.27	0.000	324.04	0.000
χ^2 :LRtest Vs linear regression	48.10	0.000	12.95	0.0015	3.65	0.1615
Community random effect (SD)	.3558		.2316		.2581	
Mother's random effect (SD)	.5209		.4625		.3699	
Sample-size (no of children)	9622		9622		9622	
No. of communities	596		596		596	
No of mothers	7568		7568		7568	

***p<0.1; **p<0.05; ***p<0.01; †Reference group; LR=-Likelihood ratio; SD=Standard deviation; TV=Television**

wasting. And the other health variables we used i.e. distance from near health stations and health access is insignificance and removed from the final model. Similar to our findings Kamiya in 2011 in Lao confirms that, contrary to the expectation, the proportion of children per community whose mothers received antenatal care from skilled personnel during the last pregnancy exhibited a negative impact on weight-for-age.

V. CONCLUSIONS AND RECOMMENDATIONS

This study has provided evidence on the socioeconomic determinants of child health outcomes in Ethiopia. Some important and relevant policy implications are drawn from the empirical findings. There is now a global consensus that certain types of nutrition interventions, such as breastfeeding, supplementation of micronutrients, and some healthcare services are effective in improving the nutritional status of children in low-income countries (UN, 2001 andBhutta ZA et al., 2008). These interventions are primarily targeted for eliminating immediate

causes of childhood undernutrition at the individual level. The empirical results indicate that the causes of undernutrition among Ethiopian children are rooted in socioeconomic factors. It implies that shorter-term interventions which aim to remove the immediate causes are not sufficient to achieve longer-term improvement in child health but should be undertaken together with broader social policies to tackle the underlying and basic causes. For example, the empirical results showed that the poor condition of sanitation and water had negative impacts on both acute and chronic undernutrition of children. Since the percentage of population with access to improved sanitation facilities in Ethiopia is the lowest (36.77%) (Table 5), investment in sanitation facilities should be given a high priority as a country strategy for social and human development.

In general, the results have provided evidence on the socioeconomic background of undernourished children in Ethiopia. Children from the disadvantaged households, in terms of geographical location, parental education, household's asset, availability of local health services, sanitation, and water, suffered a greater risk of being undernourished than those living in the better-off environment. Considering the limited financial and human resources for health spending in Ethiopia, priority of social policies for improving nutrition should be given to the most vulnerable children. Consequently, policymakers should deliberate a plan on how to deliver necessary resources to such populations by collecting more evidences on the profile of undernourished children in Ethiopia.

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AUTHORS

First Author – Anware Mohammed Ali, Department of economics, Jimma University, Ethiopia, Email: anuwar113@gmail.com
Second Author – Muhdin Muhammedhussen Batu, Department of economics, Jimma University, Ethiopia, Email: muhidmoha@gmail.com
Third Author – Krishan Kanta Kaushik, Department of economics, Jimma University, Ethiopia, Email: krishankantakaushik@gmail.com