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Magnitude and Factors Associated with Malnutrition in Under Five Children in Semen Shoa Zone, Amhara Region, Ethiopia

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Abstract

Proper nutrition is one of the most fundamental aspects of health care. Based on weight–for–age anthropometric index (Z–score) child nutrition status is categorized into three groups severely undernourished (<-3.0), moderately undernourished (-3.0 to -2.00) and nourished (> -2.0). This study was conducted to identify the determinant factors of under-five children's malnutrition in North Shoa Zone, Amhara Region Ethiopia using ordinal logistic regression model. Community based Cross-Sectional study design was used to collect data from December 2016 to June 2017. A stratified sampling technique was adopted to select 500 under-five age children of the zone and descriptive statistics, bivariate and ordinal logistic regression model were used to analyse the data and identify predictor variables of the dependent variable of Malnutrition. Results of the study showed that prevalence of severely malnutrition in the study area was 34.2%, underweight, 41.5% stunting and 24.3% wasting. The percentage distributions of child malnutrition status differ by their feeding status. Accordingly, out of those who had low feeding status were 46.5% severely malnourished, were 22.3% mildly malnourished and 31.2% were nourished. The OLR model – proportional odds model showed that child feeding status, duration of breast feeding, distance to health center, size of child at birth, had fever in the last 2 weeks, when child put to breast, had diarrhea in the last two weeks and preceding birth interval are found to be significant predictors of child malnutrition status. Children who were small in size at the time of birth need special care because those children are more likely to be under nourished. Furthermore, Children who have low feeding status are more at risk, so the concerned bodies should plan to address those problems.

Key Words: Malnutrition, Ordinal logistic regression, under-five children

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Introduction

Proper nutrition is one of the most fundamental aspects of health, but today, malnutrition (measured as poor anthropometric status) continues to be a significant health concern and remains as the single largest cause of child mortality around the world. Poor nutrition can have irreversible effects, permanently impacting a child's cognitive development, immune system, and overall growth (WHO, 2000). Malnutrition has been responsible, directly or indirectly, for 60% of the 10.9 million deaths annually among under-five children. Over two - third of these deaths, which are often associated with inappropriate feeding practice occur during the first year of life (WHO, 2002).

Over one-third of all child deaths are due to malnutrition, mostly from increased severity of disease (UNICEF, 2009). Roughly 30% of children in the world were undernourished and in fact 60% of children who die off common diseases like malaria and diarrhea would not have died had not they not been malnourished in the first place (World Bank, 2006).

The problem is much more severe in developing countries. Around 50% of children in South Asia are undernourished as compared to about 25% in Sub-Saharan Africa (UNICEF, 2013). A study conducted in India shows that 62% of the sampled children are the victim of malnutrition (Lance, John and Ralph, 2003). More than 25% under five children in the developing world are malnourished which accounts about 143 million children. In 2011, in the Horn of Africa 13 million people (half of them children) were hungry and at risk of malnutrition (Save the children,2012). In Kenya study results showed that close to 40 % of children were stunted (Benta, James and Elizabeth, 2012).

According to global estimates taking available data for the years 2000–2006, the prevalence of underweight and stunting among under five children in sub-Saharan Africa were 28% and 38% respectively, while among least developed countries in general it was 35% and 42% respectively (UNICEF, 2008).

Malnutrition is one of the leading causes of morbidity and mortality in children under five years of age in Ethiopia. The country has the second highest rate of malnutrition in Sub-Saharan Africa (FMOH, 2008). According to the (Ethiopian DHS, 2005), the prevalence of underweight, stunting, and wasting was very high; 38%, 52%, and 12% respectively (De Onis *et al*., 2004). From Ethiopian DHS (2005) 29%, 44% and 10% children are underweight, stunted, and wasted respectively. Woldemariam Girma and Timotiows Genebo (2002) on their work showed that 47 percent of the Ethiopian children are underweight (low weight – for-age) and 16 percent were severely underweight.

A community based cross-sectional survey conducted in West Gojam zone, Amhara region revealed that 49.2% children were found to be under-weight, 43.2% of the children under age five were suffering from chronic malnutrition and 14.8% acutely malnourished (Teshome *et al*., 2006). According to research conducted in Gimbi district Oromia region indicated that, 32.4% stunted, 23.5% underweight and 15.9% of the children were wasted.

Rural children are more likely to be underweight 27% than urban children 13%. The proportion of underweight children varies by region. Addis Ababa has the lowest proportion of underweight children, at 7%, while Affar has the highest prevalence of underweight children, at 46%. The proportion of underweight children is nearly four times higher for those born to uneducated mothers than for those whose mothers have more than secondary education (29% versus 7%).

Kasahun Takele (2013) and Ethiopian DHS (2011) when they analyzed the data using Bayesian approach with Markov chain Monte Carlo (MCMC) techniques, they found sex of child, preceding birth interval, birth order of child, place of residence, mother's education level, toilet facility, number of household members, household economic status, cough, diarrhea and fever as the most important indicators on child death. This problem was still affecting life of many children's thus determinant factors should be identified and tackled.

There were insufficient sources regarding malnutrition status of children in Semen Shoa Zone, Amhara Region, Ethiopia. The aim of this research was to explore major factors which contribute to child malnutrition status in this particular area using ordinal logistic regression analysis.

In Ethiopia, child malnutrition was one of the most serious public health problems and the highest in the world (Alemu, Nicola and Belele, 2005). In line with the above reality, the research attempted to come up with possible solution and recommendation on magnitude and determinant factors of under-five children's malnutrition in Semen Shoa Zone, Amhara Region, Ethiopia using ordinal logistic regression model.

Material and Methods

A community-based cross – sectional study design was used to assess magnitude and factors associated with malnutrition in under – five children in Semen Shoa Zone Amhara Region, Ethiopia from December 2016 to June 2017. The Study population was all children under the age of five years living in Semen Shoa Zone Amhara Region, Ethiopia.

Sample Size Determination

The sample size was determined on the bases of national under five malnutrition prevalence (29%) (Ethiopian DHS, 2011). It was calculated using formula for the minimum sample size needed for an interval estimate of a population proportion.

$$n = \frac{Z_{\alpha/2}^{2} PQ}{d^2} * DEFF$$

Where, Z=95%confidence interval under normal curve (1.96), d = precision required (allowable error) (5%), P=expected prevalence or proportion (29%) [13].

DEFF= 1.5=the minimum design effect (DEFF) is a “correction factor” to account for the heterogeneity between clusters with regard to the measured indicator (Cochran, 1977).

n = sample size = 317

Considering design effect of 1.5 then 317*1.5 = **476** and allowance for possible non – response rate of 5% makes the final sample size; **476+24= 500**

We use stratified sampling technique was adopted and then using proportional allocation to the rural and urban based on population; 528 (84%) samples from the rural kebeles and 100 (16%) samples from the urban kebeles was taken.

Variables in the Study

Based on weight – for – age anthropometric index (Z-score) child nutrition status is categorized into three groups

- severely undernourished (< -3.0 Z-score)
- moderately undernourished (-3.0 to -2.0 Z-score) and
- Nourished (>-2.0 Z-Score)

Five categories of factors were assessed as independent variables;

Socio-Economic and Demographic Variables: family size, income, place of residence, maternal/paternal education, marital status of the respondent, information access and religion.

Child Characteristics: Age, Sex, birth order, preceding birth interval, size at birth, having fever recently, Experience of cough and having diarrhea recently.

Child Caring Practices: feeding practice, maternal access to health facilities, and Vaccination status of a child.

Maternal Caring and Characteristics: number of children ever has born, maternal health care, Breast feeding practice.

Environmental Health Condition: Water supply, sanitation and housing conditions

Table 3.1: Sample Size Determination Method

Selected Area	Total Kebele	Total population	Total Children	Sample Selection
Debre Birhan town	9	97969	13265	80
Basona Werena	30	136195	18441	111
Menze Gira (Mehal Meda)	20	119668	16203	98
Merabeta (Alem Ketema)	23	142324	19271	116
Shewarobit	6	52367	7091	43
Hagere Mariam	20	64269	8702	52
Grand Total	**108**	**612,792**	**82,973**	**500**

Statistical Models

The study attempted to develop an ordinal logistic regression (OLR) model to identify the determinants of Malnutrition of under-five children in Semen Shoa Zone, Amhara region Ethiopia.

The conditional probability that the $\boldsymbol{i^{th}}$ success given the vector of predictor variables $\boldsymbol{X_i}$ is denoted by $P_i = P(y_i = 1|X_i)$, the expression P_i in logistic regression model can be expressed in the form of: $P_i = P(y_i = 1|X_i) = \frac{e^{X_i\beta}}{1+e^{X_i\beta}}$, $i = 1,2, \dots, n$ ……………………………………… 3.1

Where $P(y_i = 1|X_i)$ is the probability of i^{th} success given his/her individual characteristics X_i, and $\beta = (\beta_0, \beta_1, \dots, \beta_k)^T$ is a vector of unknown coefficients with dimension of $(k + 1) \times 1$. This is computed using the log it transformation of the probability of i^{th} success which is given by: $logit[P_i] = log\left(\frac{P_i}{1-P_i}\right) = \sum_{j=0}^{k} \beta_j X_{ij}$, $i = 1,2, \dots n; j = 0,1, \dots, k$ ………………… 3.2

Let Y be the categorical variable with C ordered categories. Cumulative probability reflects the ordering with: $Pr(Y \leq 1) \leq pr(Y \leq 2) \leq \dots \leq pr(Y \leq c) = 1$ ……………………… (3.3)

Let, $\pi_i = Pr(Y \leq i)$, $i = 1, \dots, c - 1$ ………………………………………………… (3.4)

Then the odds of the first i cumulative probability are:

$$odds(Y \leq i) = \frac{pr(Y \leq i)}{1-pr(Y \leq i)} = \left[\frac{\pi_i}{1-\pi_i}\right], i = 1,2, \dots, c - 1 \quad \dots\dots (3.5)$$

The POM models the log –odds (logits) of the first i cumulative probabilities as:

$$logit[Y \leq i] = log\left[\frac{\pi_i}{1-\pi_i}\right] = log\left[\frac{\pi_i}{\pi_{i+1}+ \dots +\pi_c}\right], i = 1,2, \dots, c - 1 \quad \dots\dots (3.6)$$

For category i, OR is given by:

$$OR_i = \frac{\frac{pr(Y \leq i|X^{(0)})}{1-pr(Y \leq i|X^{(0)})}}{\frac{pr(Y \leq i|X^{(1)})}{1-pr(Y \leq i|X^{(1)})}} = \frac{\left[\frac{pr(Y \leq i|X^{(0)})}{pr(Y > i|X^{(0)})}\right]}{\left[\frac{pr(Y \leq i|X^{(1)})}{pr(Y > i|X^{(1)})}\right]} = \frac{odds(0)}{odds(1)} \quad \dots\dots (3.7)$$

The model has the form:

$$logit[Y_l \leq i|\boldsymbol{x}] = ln\left\{\frac{pr(y = 1|\boldsymbol{x}) + \dots + pr(y = i|\boldsymbol{x})}{pr(y = (i + 1|\boldsymbol{x}) + \dots + pr(y = k|\boldsymbol{x})}\right\} = ln\left\{\frac{\sum_1^i pr(y = i|\boldsymbol{x})}{\sum_{i+1}^k pr(y = i|\boldsymbol{x})}\right\}$$

$$= \alpha_i - \{(\beta_1 + \gamma_{i1})x_1 + \dots + (\beta_q + \gamma_{iq})x_q + (\beta_{q+1}x_{q+1}) + \dots + (\beta_p x_p)\}$$

$$= \alpha_i - \sum_{j=1}^{q}(\beta_j + \gamma_{ij})x_i - \sum_{j=q+1}^{p}\beta_j x_j, \; \ldots. (3.8) \text{ Where } i = 1, \ldots, C-1$$

For notational simplicity, let Y_{il} denote binary indicator variables of the response for subject $\boldsymbol{l}$, such that $y_{il} = 1$ if $y_l \leq i$ and $y_{il} = 0$ otherwise ($i = 1, \ldots, c$; $\boldsymbol{l} = 1, \ldots, n$). Then:

$$\pi_i(x_l) = pr(Y_l \leq i|x_l) = pr(Y_{il} = 1|x_l) = \frac{e^{(\alpha_i - \beta_1 x_{1l} - \ldots - \beta_p x_{pl})}}{1 + e^{(\alpha_i - \beta_1 x_{1l} - \ldots - \beta_p x_{pl})}} = \frac{e^{(\alpha_i - x_l'\beta)}}{1 + e^{(\alpha_i - x_l'\beta)}} \ldots\ldots\ldots\ldots (3.9)$$

For estimates of $\boldsymbol{\beta}$ and α_i may be obtained by standard maximum likelihood methods. To apply this method, each observation can be considered as Bernouli trial and by the assumption that each y_{il} is independent, the joint distribution of the observed values can be written as:

$$Pr(Y_{11} = y_{11}, Y_{12} = y_{12}, \ldots, Y_{1n} = y_{1n}, \ldots, Y_{21} = y_{21}, \ldots, Y_{(c-1)1} = y_{(c-1)n}|x_l)$$
$$= \prod_{l=1}^{n}\prod_{i=1}^{c-1} Pr(Y_{il} = y_{il}|x_l) = \prod_{l=1}^{n}\prod_{i=1}^{c-1}[\pi_i(x_l)]^{y_{il}}[1 - \pi_i(x_l)]^{1-y_{il}} \ldots\ldots\ldots (3.10)$$

The likelihood function $L(\beta^*)$ given n observation can be expressed as:

$$L(\beta^*) = \prod_{l=1}^{n}\prod_{i=1}^{c-1}\left[\frac{e^{(\alpha_i - x_l'\beta)}}{1 + e^{(\alpha_i - x_l'\beta)}}\right]^{y_{il}}\left[1 - \frac{e^{(\alpha_i - x_l'\beta)}}{1 + e^{(\alpha_i - x_l'\beta)}}\right]^{1-y_{il}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.11)$$

Here β^* is used somewhat imprecisely to denote both the slope coefficients and intercept coefficients. It follows that the log-likelihood function is:

$$l(\beta^*) = \sum_{l=1}^{n}\sum_{i=1}^{c-1}\{y_{il}\, ln\, \pi_i(x_l) + (1 - y_{il})\, ln(1 - \pi_i(x_l))\}$$

$$= \sum_{l=1}^{n}\sum_{i=1}^{c-1}\left\{y_{il}\, ln \frac{e^{(\alpha_i - x_l'\beta)}}{1 + e^{(\alpha_i - x_l'\beta)}} + (1 - y_{il})\, ln\left(\frac{1}{1 + e^{(\alpha_i - x_l'\beta)}}\right)\right\} \ldots\ldots\ldots (3.12)$$

The unknown parameter estimates are obtained by differentiating $l(\beta^*)$ with respect to each parameters and setting each result to zero. However, the equation does not have an analytical solution (the normal equations are highly non-linear in the parameters). The estimates can be found by maximizing the equation using iterative techniques such as Newton – Raphson method.

Results and Discussion

Description of Demographic Variables

A total of 500 children under-five years of age selected from the target population severely malnutrition considered out of which 34.2%, 41.5% and 24.3% were under-weight, stunting and wasting respectively in the selected area. The mean age of the children was 41.54 months or (3.46 year) and the average age of the respondent (care giver) was 28.76 year in the study. According to the study, the average monthly income of the household was 754.625 birr with standard deviation of 523.182.

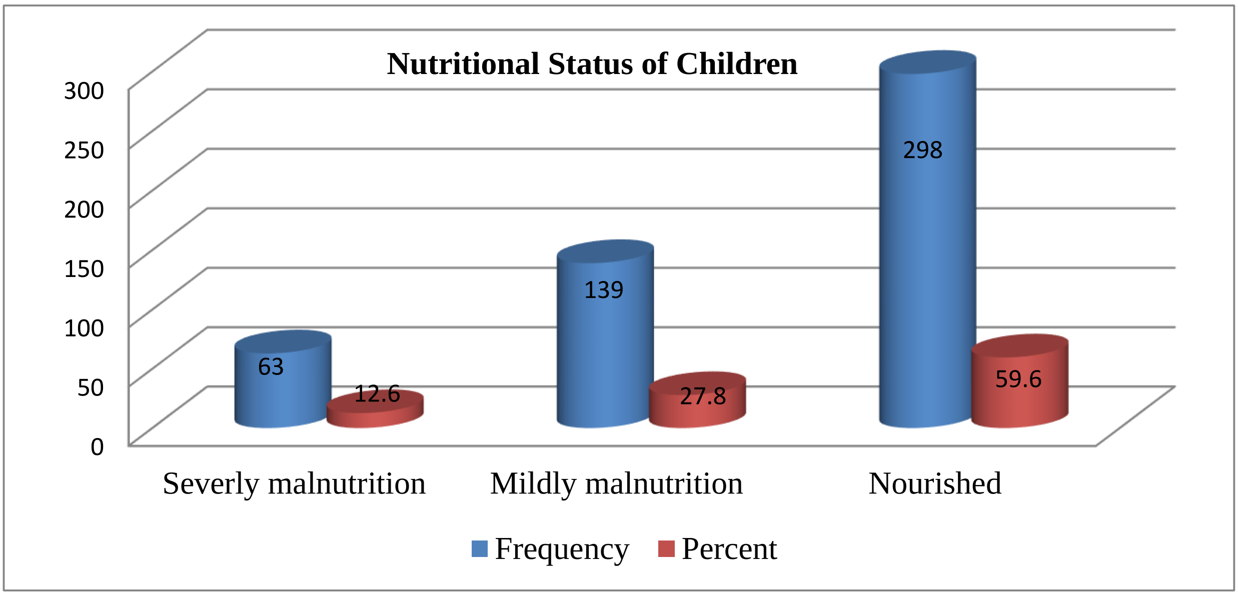

Figure 4.1: Nutritional status of children

As table 4.1 depicts 72.4%, 24.5% and 3.1% of children who were breast feeding were nourished, mildly malnutrition and severely malnutrition, respectively at the time of data collection, These proportions were 64.9%, 28.7% and 6.4% for those children who were ever breast fed, but not currently, whereas for never breast fed children these proportions were 39.8%, 9% and 51.2%, respectively. The percentage distributions of child malnutrition status differ by their feeding status. Accordingly, out of those who had low feeding status were 46.5% severely malnourished, 22.3% are mildly malnourished and 31.2% were nourished. These figures were 9.7%, 23.1% and 67.2% for those who had medium feeding status, respectively. Similarly, 6.6%, 21.8%, and 71.6% proportions for those who had high feeding status, respectively.

Based on 500 under-five children 11% had diarrhea. Out of those who had diarrhea in the last two weeks 13.5% severely malnutrition, 22.8% mildly malnutrition, 63.7% nourished. These results were 6.7%, 12.2% and 81.1% for those children who had no diarrhea in the last two weeks, respectively. And also 12.6% of them had fever. Children who had fever in the last two weeks 12.7% were severely malnutrition, 21.7% were mildly malnutrition, and 65.6% were nourished. The proportion of child malnutrition status varies, when child put to breast.

Out of those children getting breast milk immediately after birth, 8.6% were severely malnutrition, 23.9% were mildly malnutrition, and 67.5% were nourished. These proportions were 6.2%, 26.2% and 67.6% for those children who get breast milk within an hour.

Table 4.1: Nutrition status of children according to selected independent variables

Variables	**Levels**	**N**	**Nutritional Status of Children**		
			Sever	Mild	Nourished
Child feeding status per day	Low(0-6 times)	39 (5.0%)	46.5%	22.3%	31.2%
	Medium(7-9 times)	303 (60.6%)	9.7%	23.1%	67.2%
	High(10-12 times)	172 (34.4%)	6.6%	21.8%	71.6%
Duration of breast feeding	Still breasting	322 (64.4%)	3.1%	24.5%	72.4%
	Ever breasted, not currently	159 (31.8%)	6.4%	28.7%	64.9 %
	Never breast	19 (3.8%)	51.2%	9.0%	39.8%
Weight of child at birth	Below Standard (Normal)	70 (14.0%)	15.5%	21.2%	63.3%
	Standard (Normal)	289 (57.8%)	12.1%	25.5%	62.4%
	Above Standard (Normal)	141 (28.2%)	8.9%	21.8%	69.3%
Distance to health center (in kilo meter)	Less than 1 km	66 (13.2%)	22.5%	12.1%	65.4%
	1 to 2 km	123 (24.6%)	39.7%	16.7%	43.6%
	Greater than 2 km	311 (62.2%)	41.0%	20.0%	39.0%
Had fever in the last 2 weeks	No	437 (87.4%)	19.4%	13.3%	67.3%
	Yes	63 (12.6%)	12.7%	21.7%	65.6%
When child put to breast after delivery	Immediately	275 (55.0%)	8.6%	23.9%	67.5%
	Within an hour	28 (5.6%)	6.2%	26.2%	67.6%
	One hour later	197 (39.4%)	8.9%	29.2%	61.9%
Had diarrhea in the last 2 weeks	No	445 (89%)	6.7%	12.2%	81.1%
	Yes	55 (11%)	13.5%	22.8%	63.7%
Preceding birth interval	No preceding	192 (38.4%)	11.2%	19.2%	69.6%
	1-2 years	173 (34.6%)	21.3%	29.5%	49.2%
	3-4 years	96 (19.2%)	10.4%	25.2%	64.4%
	5 year and above	39 (7.8%)	5.5%	14.1%	80.4%

Result displayed in Table 4.2 was variables which had significant association with the dependent variable at 5% level of significant, which were child feeding status, duration of breast feeding, size of child at birth, Distance to health center (in kilo meter), had fever in the last 2 weeks, when child was given breast, had diarrhea in the last 2 weeks, preceding birth interval. Moreover, all other variables in appendices were insignificant at the 5% level significance.

Table 4.2: Association of children nutrition status of selected independent variables

Variables	Levels	Chi-square	DF	P-value
Child feeding status	Low(0-6 times) Medium(7-9 times) High(10-12 times)	37.377	4	0.004
Duration of breast feeding	Still breasting Ever breasted, not currently Never breast	43.546	4	0.007
Weight of child at birth	Smaller than average Average Large	29.113	4	0.003
Distance to health center (in kilo meter)	Less than 1 km 1 to 2 km Greater than 2 km	27.322	4	0.012
Had fever in the last 2 weeks	Yes No	21.647	2	0.001
When child put to breast	Immediately Within an hour One hour later	32.177	4	0.006
Had diarrhea in the last 2 weeks	Yes No	11.425	2	0.000
Preceding birth interval	No preceding 1-2 years 3-4years 5 and above	17.902	6	0.009

The multiple ordinal logistic regression analysis was employed to select the most significant determinants of child Malnutrition. The results displayed in Table 4.3 show that child feeding status, had fever in the last two weeks, size of child at birth, duration of breast feeding, when child put to breast, had diarrhea in the last two weeks and preceding birth interval were found to be significant predictors of child malnutrition status.

When the proportional odds model was used in the analysis of ordinal data, the coefficients of the explanatory variables in the model were interpreted as the logarithm of the ratio of the odds of the response variable. This means that estimates of this odds ratio, and corresponding confidence intervals, can be easily found from the fitted model. The discussion and interpretation of significant variables were shown in the model as shown in Table 4.3. Duration of breast feeding was significantly related with the malnutrition status of children. As compared to never-breasted children, being severely malnourished was 23.83 and 2.39 times more likely for currently breast feeding and ever breasted, but not currently breast-feeding children, with confidence interval 2.55 to 56.31 and 2.51 to 10.55 respectively. This was consistent with prior study by Olwedo et al (2008), children who were breast-feeding at the time of the interview were 0.75 less likely than children who were not breast-feeding to be underweight.

Table 4.3: Ordinal Logistic Regression Results of malnutrition of children in (2017)

Variables	Categories	Estimate	S.E	Wald	DF	P-value	95%CI	
							LB	UB
Child feeding status	Low(0- 6 times)	1.225	0.143	19.878	1	0.001	1.087	3.117
	Medium(7-9 times)	2.112	0.312	12.174	1	0.009	1.177	4.321
	High(10-12 times)(**ref**)	.	.	.	.	.	.	.
Duration of breast feeding	Still breasting	-3.171	0.562	27.235	1	0.002	-4.031	-0.935
	Ever breasted, but not currently	-0.873	0.153	8.608	1	0.000	-2.356	0.922
	Never breasted (**ref**)	.	.	.	.	.	.	.
Distance to health center (in kilo meter)	Less than 1 km	0.746	0.201	13.718	1	0.000	0.351	1.140
	1 to 2 km	1.359	0.370	13.523	1	0.000	0.635	2.084
	Greater than 2 km (**ref**)	.	.	.	.	.	.	.
Weight of child at birth	Smaller than average	1.487	0.211	11.932	1	0.008	1.127	3.911
	Average	3.261	0.525	25.372	1	0.101	-0.124	5.467
	Large(**ref**)	.	.	.	.	.	.	.
Had fever in the last 2 weeks	No	1.857	0.372	14.432	1	0.001	0.924	3.121
	Yes(**ref**)	.	.	.	.	.	.	.
When child put to breast	Immediately	0.733	0.102	6.187	1	0.000	0.513	1.951
	within an hour	2.445	0.232	22.312	1	0.243	-1.985	4.214
	one hour later(**ref**)		.	.	.	.	.	.
Had diarrhea in the last 2 weeks	No	-0.523	0.046	5.157	1	0.012	-1.635	0.021
	Yes(**ref**)	.	.	.	.	.	.	.
Preceding birth interval	No preceding child	-2.880	0.313	18.125	1	0.000	-3.113	-1.221
	1-2 years	-1.476	0.267	4.149	1	0.002	-1.788	-0.918
	3-4 years	0.763	0.115	8.461	1	0.121	-0.235	1.688
	5 and above years(**ref**)	.	.	.	.	.	.	.

Discussions

The estimated odds ratio (exp (1.225) = 3.4) for low feeding children was 3.4 times more likely to be severely malnourished as compared to high feeding children holding all other variables constant. The odds ratio could be as low as 2.96 and as high as 22.58 with 95% confidence interval. This variable also significant while Victor (2009) and Rice et al., (2000) were conducting their research.

Child's weight at birth appears to be an important indicator of malnutrition risk. The estimated odds ratio (exp (1.487) = 4.42) or (OR=4.42) in CI (1.127, 3.911) implies that small weight children at birth was 4.42 times more likely to be severely malnourished as compared to those large size children at keeping all other covariates were fixed. This result can go up to 3.09 and can go down to 49.95 with 95% confidence interval. The result is consistent with Olwedo et al., (2008) that children who had been smaller than average at birth were 2.3 times more likely than other children to be under-weight.

Under-five children who were put to breast immediately after birth were 2.08 less likely to be severely malnourished as compared to those put to breast an hour later. The benefits of breast feeding begin from the first moments after child birth and last for many years after breast feeding ends because breast feeding offers advantages for children that cannot be duplicated by any other form of feeding (WHO, 2012).

Under–five children who had diarrhea in the last 2 weeks were 1.69 times more likely to be severely malnourished as compared to those who had no diarrhea in the last two weeks keeping all other covariates were fixed. Children experienced with diarrhea within last 2 weeks of the survey had 1.28 times higher risk of being under-nourished when comparison is made with the children having no such problem (Das and Rahman, 2011). The percentage nutritional status of children who had diarrhea recently seems to be high probability of under-weight than those children which had no diarrhea recently (Kasahun Takele, 2013).

Fever in the last 2 weeks, was found out to be significantly associated with children malnutrition status ($P<0.05$). Under–five children who had fever in the last two weeks were 6.40 times more likely to be severely malnourished as compared to those had no fever in the last two weeks keeping all other covariates were fixed.

The preceding birth interval of children was also significant predictor of malnutrition status. The estimated odds ratio (OR=17.81) implies that the likelihood of children who have no preceding birth interval being severely malnourished is 17.81 times more likely than those in the preceding birth interval of 5 and above years, holding all other variables were constant. This result is also related with the result obtained in the previous studies; Das and Rahman (2011) stated that children having birth interval < 24 months had 1.6 times greater risk of having worse nutrition status compared with the children having 48+ month's birth interval. And also Rayhan and Khan (2006) carried out a study in Bangladesh children using Cox's linear logistic regression model they found that Children with previous birth interval 0–23 months had 1.4 times and higher risk of being under weighted as compared to children with previous birth interval 48 and above months.

Conclusions

The prevalence of malnutrition was 34.2% for under-weight, 41.5% stunting and 24.3% wasting. The percentage of under-weight in the study was 12.6% sever, 27.8% mild and 59.6% nourished. From the bivariate analysis we can see that percentage distributions of child malnutrition status differ by their feeding status. Accordingly, most of children 46.5% who had low feeding status were severely malnourished. And also malnutrition status of children varies by size of child at birth, 15.5% of children were severely malnutrition which were small in size at birth. Those children who had fever in the last 2 weeks severely malnutrition were 12.7%, and mildly malnutrition were 21.7%. From the Ordinal logistic regression analysis, the independent variables child feeding status, duration of breast feeding, distance to health center (in kilo meter), size of child at birth, had been fever in the last 2 weeks, when child put to breast, had diarrhea in the last 2 weeks, and preceding birth interval were found to be significant predictors of child malnutrition status.

Authors' Contributions

GT wrote the proposal, designed the study, performed the statistical analysis, interpreted the results and finalized the manuscript. GD and GH participated in proposal writing, designed the study, coordinated data collection and supervised data entry. They also made critical review of the draft and final manuscript. All authors have read and agreed on the submitted manuscript.

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REFERENCE

Alemu, M., Nicola. J. and Belel, T. (2005). Tackling child malnutrition in Ethiopia;

Young lives project working paper, No. 19; Save the children UK.

Benta, A., Abuya, James, C. and Elizabeth, K.M. (2012). Effect of mother's education on child's nutritional status in the slums of Nairobi.

Cochran, W.G. (1977). Sampling Techniques; Third edition. John Wiley and sons (ASIA).

Das and Rahman. (2011). Application of ordinal logistic regression analysis in determining risk factors of child malnutrition in Bangladesh. *Nutrition Journal*, **10** (124).

De Onis, M., Blössner, M., Borghi, E., Frongillo, E.A. and Morris, R (2004) Estimates of global prevalence of childhood under-weight in 1990 and 2015. *JAMA*. 291: 2600-2606.

Ethiopian DHS. (2005). Central Statistical Agency, Addis Ababa, Ethiopia; September 2006:19-20.

Ethiopian DHS. (2011). Central Statistical Agency, Addis Ababa, Ethiopia; September 2012.WHO (2000) World Health Organization

Dep't of Nutrition for Health and Development.Nutrition for health and development (2000). A global agenda for combating malnutrition. WHO. Available at http://whqlibdoc.who.int/hq /WHO_ NHD_00.6.pdf.

FMOH. (2008). Program Implementation Manual of National Nutrition Program (NNP) I; A.A, Ethiopia

Kasahun, T. (2013). Semi-Parametric Analysis of Children Nutritional Status in Ethiopia: Haramaya University, Department of Statistics, Ethiopia.

Lance, B., John, M., Donald, C. and Ralph, S. (2003). A statistical study of Malnutrition: the puzzle of Wasting.

Olwedo, M.A., Mworozi, E., Bachou, H. and Orach, C.G. (2008). Factors associated with malnutrition

Rayhan, M.I., Khan, M.S.H. (2006). Factors causing malnutrition among under-five children in Bangladesh. *Pakistan Journal of Nutrition*, **5**(6):558-562.

Rice, A.L., Sacco, L., Hyder, A. and Black, R.E. (2000). Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries. Bulletin of the World Health Organization, 78:1207−1221.

Save the children. (2012). Results for Children; An update from Save the Children.

Teshome, B., Kogi, M.W., Getahun, Z. and Taye. G. (2006). Magnitude and determinants of stunting in children under five years of age in food surplus region of west Gojam zone. *Ethiopia J Health Dev* 23: 98-106.

UNICEF. (2008). The state of the world's children: Child survival. New York: UNICEF.

UNICEF. (2009). Tracking Progress on Child and Maternal Nutrition, a Survival and Development Priority.

UNICEF. (2013). child mortality; 2013 statistical snapshot.

Victor, A. (2009). A Quantitative Analysis of Determinants of Child and Maternal Malnutrition in Nigeria; Nigeria Strategy Support Program (NSSP).

Woldemariam, G. and Timotiows, G. (2002) Determinants of Nutritional Status of Women and Children in Ethiopia.
among children in internally displaced person's camps, northern Uganda. *Afr. Health Sci.* **8**(4):244-252.

WHO. (2002). World Health Report 2002. Geneva, World Health Organization.

World Health Organization, United Nations Children's Fund, World Bank, (2012). UNICEF – WHO – World Bank joint child malnutrition estimates. New York: UNICEF; Geneva: WHO; Washington, DC: The World Bank.

World Bank. (2006): New World Bank Malnutrition Report.