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Multivariate Analysis of Wasting and Stunting Among Under-Five Children in Case of Segen Area People and South Omo Zone, SNNPR, Ethiopia

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Abstract: Nutrition is the intake of food, considered in relation to the body's dietary needs. Good nutrition – an adequate, well balanced diet combined with regular physical activity – is a cornerstone of good health. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity. The aim of this study was to analyze the determinants of Stunting and Wasting among Under-five Children of Segen Area People and South Omo Zone, Ethiopia. A total of 339 children are selected from 5 woreda using self-administered questionnaire. From these 148 children are females and 191 are males and 35.4% of children are wasted and 54.9% are stunted. Binary logistic regression model was used to analyze the data. Among the various socio-economic, demographic and child health and care practices characteristics considered, residence, Primary mothers education level, sex of the child (female) are significantly associated with wasting. Rural residence, mothers' education level and female child were remained to be significantly associated with stunting. The prevalence rate of malnutrition in the study area was found high and this was coupled with association of many independent variables. Family religion, mothers' occupation, mothers education level, family food source, source of drinking water (public tap), child sex, child order, duration of breast feeding, vaccination status, prenatal and postnatal care, Diharrea and Fever are associated with wasting and stunting.

Keywords: Under Five Children, Nutrition, Stunting, Wasting

1. Introduction

Nutritional status is the result of complex interactions between food consumption and the overall status of health and health care practices. Numerous socioeconomic and cultural factors influence patterns of feeding children and the nutritional status of women and children. The period from birth to age two is especially important for optimal growth, health, and development. Unfortunately, this period is often marked by micronutrient deficiencies that interfere with optimal growth. Additionally, childhood illnesses such as diarrhea and acute respiratory infections (ARI) are common. For women, improving overall nutritional status throughout the life cycle is crucial to maternal health. Women who become malnourished during pregnancy and children who fail to grow and develop normally due to malnutrition at any time during their life, including during fetal development, are at increased risk of prenatal problems, increased susceptibility to infections, slowed recovery from illness, and possibly death. Improving maternal nutrition is crucial for improving children's health. The nutritional status of children under age five is an important outcome measure of children's health [1].

Malnutrition, in all its forms, includes under nutrition (wasting, stunting, underweight), inadequate vitamins or minerals, overweight, obesity, and resulting diet-related non communicable diseases. In 2014, approximately 462 million adults worldwide were underweight, while 1.9 billion were either overweight or obese. While in 2016, an estimated 155 million children under the age of five years were suffering

from stunting, while 41 million were overweight or obese. Around 45% of deaths among children under five years old are linked to under nutrition. These mostly occur in low- and middle-income countries. At the same time, in these same countries, rates of childhood overweight and obesity are rising [2].

In Ethiopia, 38% of children under age five are stunted or too short for their age, and 18%severely stunted. Ten percent are wasted or too thin for their height, including 3% who are severely wasted. Twenty four percent of children under five years old are underweight or too thin for their age, with 7% severely underweight. The prevalence of overweight children remained low at 1%. The prevalence of stunting has decreased considerably from 58% in 2000 to 38% in 2016, an average decline of more than 1 percentage point per year. On the other hand, the prevalence of wasting changed little over the same time period, with a wasting rate of 10% at the time of the EDHS 2016, which was the same level as in 2011. The prevalence of underweight has consistently decreased from 41% to 24% over the 16-year period [3].

The prevalence of stunting, wasting and underweight among children under-five years of age worldwide have significantly decreased since 1990. This is good news, but overall progress is insufficient and millions of children remain hungry. Although Ethiopia has shown progress, under nutrition is still public a health problem and remain a concern to its rapid economic development. Ethiopia is making progress towards food and nutrition security. Both stunting and underweight prevalence has decreased by more than 10% between 2000 and 2010. The decrease has been steady, with both falling by 1.34 percentage points per year over the 10 year period. Wasting, which measures the more immediate effect of malnutrition, seems to have fallen slightly from around 12% in 2000 and 2005, to 9% in 2010. However, Under-nutrition is still a public health problem and an overarching development concern, affecting not only food insecure areas of the country but also food secure areas. Stunting affects 44% of children under five years of age in 2011, which is too high. More than 1 out of 4 women in Ethiopia is affected by under-nutrition and anaemia, a key contributing factor to high maternal and neonatal mortality as well as infant under-nutrition [1].

2. Data and Methodology

2.1. Study Area and Population

The study was conducted in Southern Nations Nationalities and People's Region (SNNPR). The SNNPRS is located in the southern and southwestern part of Ethiopia. It is bordered with Kenya in south, Sudan in southwest, Gambella Regional State in north-west, and surrounded by Oromia Regional State in northwest, north and east. This study will be conducted on Segen Area People and South Omo zones.

2.2. Sampling Technique

Using simple random sampling a sample of five weredas (Burji, Derashe, Debub Ari, BenaTsemay and Jinka Town) are selected among 13 weredas in the study area. A data on a total of 339 children's were collected by door to door survey for a month in the selected weredas. This study was used structured questionnaire and the anthropometric measurements of the children were taken using standard procedures.

2.3. Variables of the Study

Variables considered in this study were selected based on earlier studies at the global and national level. Maternal, demographic and socioeconomic variables will take as determinants of stunting and wasting of under five children.

Table 1. *Distribution of Categorical Variables.*

Variable Type	Variables	Category
Outcome Variables	Wasting: Weight-for-Height	0 = Not wasting 1 = Wasting
	Stunting: Height-for-age	0 = Not stunted 1= Stunted
Explanatory Variables	Woreda	1 = Burji 2 = Derashe 3 = Debub Ari 4 = Benatsemay 5 = Jinka
	Residence	1 = Rural 2 = Urban
	Household Sex	1 = Female 2 = Male
	Religion	1 = Orthodox 2 = Muslim 3 = Catholic 4 = Protestant 5 = Other
Explanatory Variables	Mother Occupation	1 = House Wife 2 = Laborer 3 = Agriculture 4 = Self- Employed

Variable Type	Variables	Category
Explanatory Variables	Mother Education Level	5 = Merchant 6 = Employed in Governmental Org. 1 = Illiterate 2 = Read and Write 3 = Primary 4 = secondary and Above
	Mother Marital Status	1 = Single 2 = Married 3 = Divorced 4 = Widowed
	Family Food Source	1 = Agriculture 2 = Purchase 3 = Aid
	Source of Drinking Water	1 = Public tap 2 = other
	Child Sex	1 =Female 2 = Male
	Child Order	1 = First 2 = Second 3 = Third 4 = Fourth 5 = Fifth and Above
	Duration of Breast Feeding	1 = < 6 Month 2 = 6-12 Month 3 = 13-24 Month 4 = >24 Month
	Vaccination Status	1 = Not Vaccinated 2 = Partially Vaccinated 3 = Fully Vaccinated
	Prenatal Care	0 = Yes 1 = No
	Postnatal Care	0 = Yes 1 = No
	Diarrhea before Two Week	0 = No 1= Yes
	Fever before Two Week	0 = No 1= Yes

2.4. Method of Data Analysis: The Logistic Regression

Suppose that the study have *n* binary observations of the form y_i, $i = 1, 2,..., n$. Let Y denote a dichotomous outcome variable, which may assume values "1" if wasted and stunted and "0" otherwise. Let the vector $X' = (x_1, x_2,..., x_k)$ denote a set of k predictor variables. The general data layout can be represented as follows:

$$X = \begin{pmatrix} 1 & x_{11} & x_{12} & \dots & x_{1k} \\ 1 & x_{21} & x_{22} & \dots & x_{2k} \\ . & . & . & \dots & . \\ . & . & . & \dots & . \\ . & . & . & \dots & . \\ 1 & x_{n1} & x_{n2} & \dots & x_{nk} \end{pmatrix}_{nx(k+1)} \quad \text{and} \quad Y = \begin{pmatrix} y_1 \\ y_2 \\ . \\ . \\ . \\ y_n \end{pmatrix}_{nx1}$$

Where, X is called the design or regression matrix. And without the loading column of 1's, this design matrix is said to be predictor data matrix.

Then the logistic model which relates the probability of the event occurring to the predictor variables x is given by:

$\pi(xi)$ is the probability that i[th] children is health status used given that k predictor variables. β is a vector of unknown coefficients (i.e $\boldsymbol{\beta} = (\beta_0, \beta_1, \beta_2, \ldots, \beta_k)'$ $P(Y = 1/X = xi) = \dfrac{\exp(\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik})}{1 + \exp(\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik})} = \dfrac{e^{\mathbf{X'\beta}}}{1 + e^{\mathbf{X'\beta}}} = \pi(xi)$

and thus $P(Y = 0/X = xi) = 1 - \pi(xi)$

After performing the logit transformation on $\pi(x_i)$, the following logistic model was obtained:

$$\log it\left(\pi(xi)\right)=\log\left[\frac{\pi(xi)}{1-\pi(xi)}\right]=\beta_0+\beta_1X_{i1}+\beta_2X_{i2}+...+\beta_pX_{ip}\ ,\text{i=1,2 ? , n}$$

where log denotes the natural logarithm. This class of generalized linear models allows $\pi(x_i)$ to be related to the linear component $\beta_0+\beta_1X_{i1}+\beta_2X_{i2}+...+\beta_pX_{ip}$ by the use of a logistic link function.

Where: β_0 is the constant of the equation and, $\beta_1,\beta_2,\ldots,\beta_p$ are the coefficients of the predictor variables. The above equation is known as the logistic function.

2.4.1. Assumptions of Logistic Regression

The following assumptions of logistic regression are considered [4].

i. Linearity in the logit
ii. Normally distributed error terms are not assumed.
iii. Meaningful coding. Logistic coefficients will be difficult to interpret if not coded meaningfully. The convention for binomial logistic regression is to code the dependent class of greatest interest as 1 and the other class as 0.
iv. Logistic regression requires the dependent variable to be binary or dichotomous.
v. The categories (groups) must be mutually exclusive and exhaustive; a case can only be in one group and every case must be a member of one of the groups.
vi. Logistic regression uses Maximum Likelihood Estimation (MLE) and requires a larger sample size than would be required for OLS regression.

2.4.2. Odds Ratio

The odds ratio is the ratio between two odds. The odds of some event happening is defined as the ratio of the probability of occurrence to the probability of nonoccurrence.

The odds ratio is a value which shows the strength of association between a predictor and the response of interest (log odds of the dependent variable) in the model. It can vary from 0 to infinity. If the odds ratio is one, there is no association. So, the parameter estimates of a logistic regression can be interpreted easily in terms of odds ratios. If more than one explanatory variable are present in a model, the odds ratios for one predictor may be calculated keeping all other predictors at a fixed level.

Akaike Information Criterion (AIC) and Baye's Information Criterion (BIC) are used for model selection and maximum likelihood method was used for parameter estimation [5]. Cox and Snell and Nagelkerke methods are used to estimate the coefficient of determination. And to test the goodness of fit for logistic regression models Hosmer Lemeshow test are used. The Wald test is one of a number of ways of testing whether the parameters associated with a group of explanatory variables are zero [6]. If $\widehat{\beta}\imath$ for a particular explanatory variable or group of explanatory variables different from zero, the Wald test is significant [7].

3. Statistical Data Analysis

The aim of this study was to analyze the Determinants of Stunting and Wasting among Under-five Children of Segen Area Peopleand South Omo Zone. Burji and Derashe were randomly selected from Segen Area peoples and Debub Ari, BenaTsemay and Jinka are selected from South Omo Zone, Ethiopia. Since total number of children in the selected area was not known, a total of 339 childrens were selected from five woredas in two zones by door to door survey. The data analyses were carried out by ENA (Emergency Nutritional Assessment) and SPSS 20 software.

3.1. Descriptive Statistics

Table 2. *Frequency Distribution of Response Variables.*

Variables	Category	Frequency	Percentage
Wasting	Not wasted	219	64.4%
	Wasted	120	35.4%
Stunting	Not stunted	163	48.1%
	Stunted	176	51.9%

From table 2 this study shows that from 339 randomly selected children's 120 (35.4%) and 176 (51.9%) of children's are wasted and stunted, respectively. Whereas 219 (64.6%) and 163 (48.1%) children's are not wasted and not stunted, respectively.

Table 3. *Frequency Distribution of Categorical Variables.*

Variables	Category	Wasting		Stunting	
		Not wasted	Wasted	Not Stunted	Stunted
Woreda	Burji	47 (13.86%)	17 (5.01%)	30 (8.85%)	34 (10.03%)
	Derashe	72 (21.24%)	29 (8.55%)	48 (14.16%)	53 (15.63%)
	Debub Ari	28 (8.26%)	22 (6.49%)	28 (8.26%)	22 (6.49%)
	Benatsemay	55 (16.22%)	44 (12.98%)	42 (12.39%)	57 (16.81%)
	Jinka	17 (5.01%)	8 (2.36%)	15 (4.42%)	10 (2.95%)
Residence	Rural	147 (43.36%)	91 (26.84%)	115 (33.92%)	123 (36.28%)
	Urban	72 (21.24%)	29 (8.55%)	48 (14.16%)	53 (15.63%)
Household head Sex	Female	41 (12.09%)	14 (4.13%)	26 (7.67%)	29 (8.55%)
	Male	178 (52.51%)	106 (31.27%)	137 (40.41%)	147 (43.36%)
Religion	Orthodox	83 (24.48%)	40 (11.80%)	63 (18.58%)	60 (17.70%)
	Muslim	18 (5.31%)	3 (0.88%)	10 (2.95%)	11 (3.24%)
	Catholic	25 (7.37%)	9 (2.65%)	15 (4.42%)	19 (5.60%)
	Protestant	63 (18.58%)	37 (10.91%)	48 (14.16%)	52 (15.34%)
	Other	10 (2.95%)	31 (9.14%)	27 (%7.96)	34 (10.03%)

Variables	Category	Wasting		Stunting	
		Not wasted	Wasted	Not Stunted	Stunted
Mother Occupation	House Wife	125 (36.87%)	52 (15.34%)	85 (25.07%)	92 (27.14%)
	Laborer	10 (2.95%)	12 (3.54%)	14 (4.13%)	8 (2.36%)
	Agriculture	66 (19.47%)	45 (13.27%)	51 (15.04%)	60 (17.70%)
	Self-Employed	2 (0.59%)	2 (0.59%)	2 (0.59%)	2 (0.59%)
	Merchant	7 (2.06%)	5 (1.47%)	4 (1.18%)	8 (2.36%)
	Employed in Governmental Organization	9 (2.65%)	4 (1.18%)	7 (2.06%)	6 (1.77%)
Mother Education Level	Illiterate	121 (35.69%)	72 (21.24%)	92 (27.14%)	101 (29.79%)
	Read and Write	63 (18.58%)	33 (9.73%)	49 (14.45%)	47 (13.86%)
	Primary	22 (6.49%)	8 (2.36%)	12 (3.54%)	18 (5.31%)
	secondary and Above	13 (3.83%)	7 (2.06%)	10 (2.95%)	10 (2.95%)
Mother Marital Status	Single	16 (4.72%)	11 (3.24%)	15 (4.42%)	12 (3.54%)
	Married	193 (56.93%)	105 (30.97%)	139 (41%)	159 (46.90%)
	Divorced	3 (0.88%)	1 (0.29%)	2 (0.59%)	2 (0.59%)
	Widowed	7 (2.06%)	3 (0.88%)	7 (2.06%)	3 (0.88%)
Family Food Source	Agriculture	140 (41.30%)	89 (26.25%)	108 (31.86%)	121 (35.69%)
	Purchase	78 (23.01%)	30 (8.85%)	54 (15.93%)	54 (15.93%)
	Aid	1 (0.29%)	1 (0.29%)	1 (0.29%)	1 (0.29%)
Source of Drinking Water	Public tap	169 (49.85%)	85 (25.07%)	123 (36.28%)	131 (38.64%)
	Spring	50 (14.75%)	35 (10.32%)	40 (11.80%)	45 (13.27%)
Child Sex	Female	101 (29.79%)	47 (13.86%)	80 (23.60%)	68 (20.06%)
	Male	118 (34.81%)	73 (21.53%)	83 (24.48%)	108 (31.86%)
Child Order	First	43 (12.68%)	29 (8.55%)	29 (8.55%)	43 (12.68%)
	Second	42 (12.39%)	27 (7.96%)	38 (11.21%)	31 (9.14%)
	Third	48 (14.16%)	19 (5.60%)	34 (10.03%)	33 (9.73%)
	Fourth	32 (9.44%)	10 (2.95%)	18 (5.31%)	24 (7.08%)
	Fifth and Above	54 (15.93%)	35 (10.32%)	44 (12.98%)	45 (13.27%)
Duration of Breast Feeding	< 6 Month	23 (6.79%)	20 (5.90%)	24 (7.08%)	19 (5.60%)
	6-12 Month	84 (24.78%)	28 (8.26%)	46 (13.57%)	66 (19.47%)
	13-24 Month	106 (31.27%)	65 (19.17%)	86 (25.37%)	85 (25.07%)
	>24 Month	6 (1.77%)	7 (2.06%)	7 (2.06%)	6 (1.77%)
Vaccination Status	Not Vaccinated	7 (2.06%)	1 (0.29%)	3 (0.88%)	5 (1.47%)
	Partially Vaccinated	39 (11.50%)	27 (7.96%)	37 (10.91%)	29 (8.55%)
	Fully Vaccinated	173 (51.03%)	92 (27.14%)	123 (36.28%)	142 (41.89%)
Prenatal Care	Yes	210 (61.95%)	114 (33.63%)	157 (46.31%)	167 (49.26%)
	No	9 (2.65%)	6 (1.77%)	6 (1.77%)	9 (2.65%)
Postnatal Care	Yes	186 (54.87%)	107 (31.56%)	144 (42.48%)	149 (43.95%)
	No	33 (9.73%)	13 (3.83%)	19 (5.60%)	27 (7.96%)
Prevalence of Diarrhea	No	180 (53.10%)	99 (29.20%)	138 (40.71%)	141 (41.59%)
before Two Week	Yes	39 (11.50%)	21 (6.19%)	25 (7.37%)	35 (10.32%)
Prevalence Fever before	No	187 (55.16%)	100 (29.50%)	137 (40.41%)	150 (44.25%)
Two Week	Yes	32 (9.44%)	20 (5.90%)	23 (6.78%)	26 (7.67%)

In this study there are different explanatory variables that may affect under five age child nutritional status. In this study from table 3 there are 238 (70.2%) of child who are live in rural area and 101 (29.8%) of child in urban area. Among the selected households for investigation, 55 (16.2%) head of household are females and 284 (83.8%) are males. Mother education level from table 3 shows 193 (56.9%) are illiterate, 96 (28.3%) of mothers can be read and write, 30 (8.8%) of mothers education level are Primary and 20 (5.9%) of mothers education level are secondary and above. Among 339 mothers under study 177 (52.2%) of mothers occupation are housewife.

Table 3 shows a total of 298 (87.9%) mothers are married, 229 (67.6%) of family food source from the observed family are agriculture, 254 (74.9%) of drinking water source are public tap and 171 (50.4%) of duration of breast feedings are between 13-24 months. The above table shows that 60 (17.7%) are Diarrhea Prevalence case before two week of sample taken and 52 (15.3%) are fever prevalence in under five children.

From table 3, 26.84% and 36.28% under five children who are live in rural area are wasted and stunted, respectively. From children who are live in urban area 8.55% are wasted and 15.63% are stunted. This shows that children who live in rural are more exposed to be wasted and stunted than urban area.

Table 3 shows 21.24% illiterate mothers child are wasted and 29.78% are stunted. These percentages are lower in mothers' education level increases. For instance, the mothers' education level is secondary and above, 2.06% and 2.95% of under five children are wasted and stunted, respectively. This descriptive statistics shows mothers' educational level is highly affect children malnutrition status.

From under five children who have Diarrhea before two week of the sample taken, 6.19%, 10.32% were wasted and stunted, respectively. And 5.9% and 7.67% of under five children who have fever before two week of the sample taken are wasted and stunted, respectively.

But in case of family food source, source of drinking water, duration of breast feeding and vaccination status this descriptive measures result shows a contradict of the reality. Example, children who are fully vaccinated is highly

malnourished and vice versa.

The association between explanatory variables and outcome variable should be tested using chi-square test of association. If P-value less than the level of significance (α), the null hypothesis will be rejected and the conclusion drawn is based on alternative hypothesis.

Table 4. *Pearson X^2 Association of socio-demographic factors and wasting and stunting.*

Variable	Wasting			Stunting		
	df	Chi- square	Sig.	df	Chi-square	Sig.
Woreda	4	9.446	0.05**	4	3.998	0.016*
Residence	1	2.812	0.004*	1	0.018	0.000*
Household Sex	1	2.839	0.002*	1	0.017	0.077**
Religion	4	12.180	0.016*	4	1.058	0.001*
Mother Occupation	5	8.316	0.014*	5	3.56	0.001*
Mother Education Level	3	1.353	0.000*	3	1.165	0.000*
Mother Marital Status	3	0.657	0.833	3	2.781	0.001*
Family Food Source	2	4.132	0.007*	2	0.24	0.887
Drinking Water Source	1	1.656	0.000*	1	0.048	0.005*
Child Sex	1	1.523	0.000*	1	3.752	0.005*
Child Order	4	5.689	0.007*	4	3.823	0.031*
Duration of Breast Feeding	3	10.063	0.010*	3	3.743	0.001*
Vaccination Status	2	2.765	0.000*	2	2.337	0.011*
Prenatal Care	1	0.145	0.003*	1	0.411	0.522
Postnatal Care	1	1.186	0.000*	1	0.980	0.011*
Diarrhea Before Two Week	1	0.567	0.030*	1	1.202	0.000*
Fever Before Two Week	1	0.252	0.060**	1	0.9	0.000*

*and **shows statistically significant at 5% and 10% level of significance, respectively

Table 4 shows the Pearson X^2 test of association of those explanatory variables with explanatory variables. The P-values of mother marital status is 0.833. This value is greater than the level of significant (α = 5% and 10%) which means mothers marital status is not statistically significant. Whereas, the other explanatory variables are statistically significant at 5% and 10% level of significant.

Table 4 shows that the p-value for the two explanatory variables, (family food source and prenatal care) are greater than 5% and 10% level of significant. This indicates that they have no association with stunting at 5% and 10% level of significant. The rest explanatory variables are statistically significant at 5% and 10% level of significant and they have an association with response variables (stunting).

3.2. Multiple Binary Logistic Regression Analysis

Here this study considered two models for wasting and stunting (one with all covariates (Model I) and the other without insignificant explanatory variables (Model II)). The results of goodness of fit tests for each model are shown in Table 5. This can be done by Omnibus and Hosmere and Lemeshow test.

Table 5. *Hosmere and Lemeshow test.*

Model	Test	Wasting			Stunting		
		Chi-square	df	Sig.	Chi-square	df	Sig.
Model I	Hosmerand lemeshow	5.767	8	0.673	4.086	8	0.849
Model II	Hosmer and lemeshow	3.076	8	0.929	4.740	8	0.785

An insignificant chi-square indicates a good fit to the data and, therefore, good overall model fit. Table 5 shows the p-value for wasting is 0.673 (>0.05) for model I and 0.929 (>0.05) for model II. P- value for stunting is 0.849 for Model I and 0.785 for Model II. All are greater than α (5%) level of significant. Therefore, all logistic regression models (Model I and II) are good fit.

But to choose the best fit model among these two, Akaike information criterion (AIC) and Bayesian information criteria (BIC) formula will be used.

Table 6. *Akaike information and Bayesian information criterion for Model Selection.*

Omnibus Test			Model Selection Criterion			
Model	-2Loglikelihood		Response Variables			
	Wasting	Stunting	Wasting		Stunting	
			AIC	BIC	AIC	BIC
Model I	387.316	437.534	505.316	536.598	555.534	586.815
Model II	387.935	438.998	497.935	527.095	546.998	575.628

Table 6 shows AIC and BIC values of wasting and stunting for Model I and II. From these table both AIC and BIC are smaller in Model II than model I. Since Model II has smaller values of both AIC and BIC, conclude that Model II is a better fit to the data for all outcome variables. The result of multiple binary logistic regression for Model II are shown in Table 7 and 8 below.

Table 7. *Binary logistic regression model for wasting.*

Variables	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Woreda			1.546	4	.000			
Burji (1)	-.388	.644	.364	1	.010	.678	.192	2.396
Derashe (2)	-.253	.693	.134	1	.003	.776	.200	3.017
Debub Ari (3)	-.411	.786	.274	1	.220	.663	.142	3.091
BenaTsemay (4)	.456	.743	.377	1	.005	1.578	.368	6.766
Residence (1)	0.532	0.621	1.271	1	.000	1.702	0.324	2.627
Household Sex (1)	-.500	.413	1.466	1	.001	.607	.270	1.362
Religion			4.968	4	.000			
Orthodox (1)	-.612	.816	.562	1	.021	.542	.110	2.685
Muslim (2)	-2.025	1.088	3.464	1	.008	.132	.016	1.113
Catholic (3)	-1.017	.758	1.803	1	.385	.362	.082	1.596
Protestant (4)	-.598	.767	.608	1	.251	.550	.122	2.472
Mother Occupation			6.565	5	.000			
House Wife (1)	.070	.880	.006	1	.044	1.073	.191	6.021
Laborer (2)	.187	.999	1.412	1	.003	1.205	.462	23.238
Agriculture (3)	-.174	.949	.034	1	.009	.840	.131	5.399
Self-employed (4)	.588	1.534	.147	1	.650	1.800	.089	36.373
Merchant (5)	.625	.961	.652	1	.430	1.8682	.330	14.279
Mother Education Level			1.055	3	.000			
Illeterate (1)	-.539	.754	.510	1	.002	.583	.133	2.560
Read and Write (2)	-.232	.732	.100	1	.000	.793	.189	3.332
Primary (3)	-.524	.798	.431	1	.000	.592	.124	2.831
Family Food source			.661	2	.000			
Agriculture (1)	-.117	1.967	.004	1	.000	.890	.019	41.985
Purchasing (2)	-.502	1.960	.066	1	.513	.605	.013	28.200
Public tab (1)	-.583	.497	1.376	1	.179	.558	.211	1.478
Female (1)	-.179	.264	.459	1	.000	.836	.498	1.404
Child order			8.304	4	.001			
First (1)	.260	.413	.395	1	.000	1.296	.577	2.911
Second (2)	-.210	.399	.277	1	.004	.811	.371	1.773
Third (3)	-.589	.413	2.038	1	.005	.555	.247	1.246
Fourth (4)	-.944	.475	3.942	1	.029	.389	.153	.988
Duration of Breast Feeding			9.085	3	.000			
<6 month (1)	-.269	.830	.105	1	.002	.764	.150	3.884
6-12 month (2)	-1.298	.706	3.379	1	.011	.273	.068	1.090
13-24 month (3)	-.533	.675	.623	1	.000	.587	.156	2.204
Vaccination Status			3.491	2	.000			
Not vaccinated (1)	-2.402	1.286	3.491	1	.062	.091	.007	1.125
Partially Vaccinated (2)	-.240	.452	.282	1	.000	.787	.325	1.907
Prenatal care (1)	.383	.666	.329	1	.000	1.466	.397	5.413
Postnatal care (1)	.667	.450	2.196	1	.110	1.949	.806	4.712
Diharrea (1)	.091	.431	.045	1	.000	1.095	.471	2.547
Fever (1)	-.359	.451	.634	1	.005	.698	.288	1.691
Constant	1.488	2.642	.317	1	.001	4.429		

Table 8. *Binary logistic Regression model for Stunting.*

Variables	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Woreda			2.543	4	.010			
Burji (1)	.254	.579	.192	1	.000	1.289	.414	4.011
Derashe (2)	.298	.595	.250	1	.000	1.347	.419	4.325
Debub Ari (3)	-.258	.709	.132	1	.350	.773	.192	3.102
BenaTsemay (4)	.570	.678	1.291	1	.005	1.768	.572	8.151
Residence (1)	.444	0.531	1.883	1	.001	1.559	0.265	7.562
Household Sex (1)	.018	.411	.002	1	.000	1.018	.454	2.280
Religion			.321	4	.000			
Orthodox (1)	-.115	.713	.026	1	.000	.891	.220	3.606
Muslim (2)	.022	.868	.001	1	.020	1.022	.186	5.606
Catholic (3)	-.293	.673	.189	1	.000	.746	.200	2.792
Protestant (4)	-.060	.665	.008	1	.311	.942	.256	3.466
Mother Occupation			1.883	5	.000			
House Wife (1)	-.121	.808	.022	1	.000	.886	.182	4.319
Laborer (2)	-.664	.941	.498	1	.011	.515	.081	3.257
Agriculture (3)	-.228	.874	.068	1	.011	.796	.143	4.418

Variables	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Self-employed (4)	-.252	1.397	.033	1	.551	.777	.050	12.010
Merchant (5)	.492	.940	.274	1	.350	1.636	.259	10.325
Mother Education Level			.315	3	.000			
Illeterate (1)	.074	.695	.011	1	.005	1.077	.276	4.208
Read and Write (2)	-.066	.691	.009	1	.000	.937	.241	3.632
Primary (3)	-.181	.746	.059	1	.001	0.834	.278	5.168
Mother Marital Status			3.090	3	.002			
Single (1)	.474	.956	.656	1	.712	1.606	.333	14.120
Maried (2)	.272	.877	2.104	1	.000	1.313	.640	19.919
Divorced (3)	.143	1.356	.711	1	.021	1.154	.220	44.705
Public tab (1)	-.483	.453	1.135	1	.380	.617	.254	1.499
Female (1)	-.334	.243	1.899	1	.011	.716	.445	1.152
Child order			3.359	4	.000			
First (1)	.254	.391	.423	1	.000	1.289	.600	2.773
Second (2)	-.372	.375	.984	1	.005	.689	.330	1.438
Third (3)	-.124	.374	.111	1	.459	.883	.424	1.838
Fourth (4)	.231	.422	.301	1	.397	1.260	.552	2.880
Duration of Breast Feeding			3.284	3	.000			
<6 month (1)	.104	.763	.019	1	.011	1.110	.249	4.950
6-12 month (2)	.312	.644	1.221	1	.022	1.366	.577	7.201
13-24 month (3)	.365	.630	.336	1	.000	1.441	.419	4.952
Vaccination Status			3.966	2	.000			
Not vaccinated (1)	.529	.891	.669	1	.497	1.697	.361	11.888
Partially Vaccinated (2)	-.588	.398	2.183	1	.000	.556	.255	1.212
Postnatal care (1)	.237	.392	.367	1	.002	1.267	.366	10.700
Diharrea (1)	-.776	.407	3.640	1	.000	.460	.207	1.021
Fever (1)	-.652	.417	2.441	1	.008	.521	.447	4.347
Constant	-.741	1.681	.194	1	.000	.477		

3.2.1. Evaluation of the Final Model: Pseudo R Square

Table 9. *Model Summary for Wasting and Stunting.*

Model	Pseudo R squares	
	Cox & Snell R Square	Nagelkerke R Square
Wasting	0.192	0.264
Stunting	0.118	0.158

Both the Cox and Snell and Nagelkerke R squared values can be interpreted in a similar manner to how you would the R square value in regression – the percentage of variability in data that is accounted for by the model. This table shows that all models are good enough.

3.2.2. Diagnostic Checking

The standardized and deviance residuals reveal that all have values of less than absolute value of 3 indicating the absence of outliers in the model. In addition, there are no large values of Cook's distance (Di<1) which means that there are no influential cases having an effect on the model (Cook's). And there are no high values of DFBETAS (all values less than 2/sqrt (n) =0.1086) which means that there are no influential observations for the individual regression coefficients for all models (Wasting and stunting). Therefore, the models are adequate.

3.2.3. Discussion and Interpretation of Results

From 339 randomly selected under five children in South Omo zone and Segen Area Peoples from five woredas 120 (35.4%) and 176 (51.9%) of children's are wasted and stunted, respectively. The statistic shows there are high nutritional problems in the selected places.

Using Jinka woreda as reference category the odds ratio will be interpret that obtained in table 7. The odds of under five children being wasted has decreased by a factor of 0.678 for Burji as compared to Jinka controlling for the other variables in the model. Likewise, the odds ratio for Derashe and Debub Ari are 0.776 and 0.663, respectively, which indicates that the odds of under five children being wasted has decreased by a factor of 0.776 for Derashe as compared to Jinka controlling for the other variables in the model. But the odds of under five children being wasted has increased by a factor of 0.368 for Bena Tsemay as compared to Jinka controlling for the other variables in the model.

For the variable child place of residence, the reference category is urban; the odds of children living in rural area are wasted increased by a factor of 1.702 compared to urban area. Children living in rural area are 70.2% more likely to be wasted as compared to urban area children.

Household sex is one predictor variable in this study, male is reference variable, the odds of child being wasted has decreased by a factor of 0.607 for females as compared to male.

In table 7 religion is on explanatory variable. By referring other religion category, the odds of being wasted has decreased by a factor of 0.542, 0.132, 0.362 and 0.55 for Orthodox, Muslim, Catholic and Protestant, respectively controlling other variables in the model.

Mothers' education level was one of the explanatory variables in this study. By using secondary and above education level as a reference variable, the odds of children being wasted has decreased by 0.583, 0.793 and 0.592 for illiterate mother, read and write and primary educated mother,

respectively controlling for the other variables in the model. Severe acute malnutrition is associated with maternal education [9, 10].

Taking aid as a reference variable in family food source, the odds of child being wasted are decreased by a factor of 0.890 for agriculture controlling for the other variables in the model.

Child sex is very important variable in this study. By taking male as a reference category, the odds of female children being wasted is decreased by 0.836 as compared to male controlling for the other variables in the model.

For the variable child order, taking fifth and above as a reference category, the odds of children being wasted has increased by 29.6% for first order children controlling for the other variables in the model. Whereas, the odds of being wasted have decreased by 0.811, 0.555 and 0.389 for second, third and fourth order children, respectively.

Breast feeding plays a great role for children development. Duration of breast feeding is one variable in this study, taking 25 month and above as a reference category, the odds of children being wasted has decreased by 0.764, 0.273 and 0.587 for less than 6 month, 6-12 month and 13-24 month breast feeding, respectively controlling for the other variables in the model.

Taking fully vaccinated as a reference category in vaccination status variable, the odds of being wasted has decreased by a factor of 0.091 and 0.787 for not vaccinated and partially vaccinated children, respectively. This shows that not vaccinated children are more likely to be wasted than vaccinated one.

Clinical follow up was very important for mothers' health and child development. Hence prenatal and postnatal cares were used for this study. Taking prenatal and postnatal care as a reference category, mothers' who are not taking prenatal and postnatal care for their children are being wasted were increased by 46.6% and 94.9%, respectively. Children whose mothers attended ANC (AOR: 0.18, 95% CI: (0.18 (0.07–0.45) were associated with wastingThis shows clinical follow up was very essential to reduce children nutritional problem [11].

Prevalence of Diharrea and Fever before two week of children investigation was used in this study. By taking prevalence of Diharrea as reference category, the odds of children being wasted was increased by 9.5% for those no Diharrea. The presence of diarrhea (AOR: 39.5, 95% CI: (13.68–114.30) is associated with wasting. But taking prevalence of Fever as reference category, the odds of being wasted was decreased by a factor of 0.698 for no Fever children controlling for the other variables in the model [11].

The odds of children being stunted for Burji, Derashe and Bena tsemay were increased by 28.9%, 34.7% and 76.8%, respectively controlling for the other variables in the model by taking Jinka woreda as reference category in table 8.

For the variable child place of residence, taking urban as a reference category; the odds of children living in rural area being stunted increased by a factor of 1.559 compared to urban area. This means children living in rural area are 55.9% more likely to be stunted as compared to urban area children controlling for the other variables in the model.

Household head sex is one predictor variable in this study, male is reference variable, the odds of child being stunted has increased by a factor of 1.018 for females household as compared to male household controlling for the other variables in the model. Looking results in wasting, children are more likely to expose to be stunted for male household.

Table 8 also shows taking other religion category as a reference, the odds of being stunted has decreased by a factor of 0.891, 0.746 and 0.942 for Orthodox, Catholic and Protestant, respectively controlling other variables in the model. But 2.2% Muslim families are more likely to be stunted.

Taking mothers employed in governmental organization as a reference category, the odds of being stunted has decreased by a factor of 0.886, 0.515 and 0.796 for housewife, labourer and agriculture, respectively. But the odds of merchant mothers being stunted has increased by 63.6% controlling for the other variables in the model.

By taking secondary and above education level of mother as a reference category, the odds of children being stunted has increased by a factor of 1.077 for illiterate mothers. But for mothers who can read and write and mothers have primary education level, the odds of being stunted has decreased by a factor of 0.937 and 0.834, respectively controlling for the other variables in the model. Severe acute malnutrition is associated with maternal education [9].

This model shows that all category of mother marital status have an increasing effect on stunting. Taking widowed as a referencing category, the odds of being stunted for single, married and divorced are increased by 60.6%, 31.3% and 15.4%, respectively controlling for the other variables in the model. Further investigation is needed because all effects are an increasing effect.

Taking male as a reference category, the odds of female children being stunted is decreased by 0.716 as compared to male controlling for the other variables in the model. Sex of child (AOR: 0.75; 95% CI: 0.57-1.0) is highly significant association with stunting [12].

For the variable child order, taking fifth and above as a reference category, the odds of children being stunted has increased by 28.9% and 26% for first order and fourth order children, respectively controlling for the other variables in the model. But the odds of being stunted have decreased by a factor of 0.689 and 0.883 for second and third children order, respectively. At 5% level of significant third order children are not significant because P-value is 0.459.

Duration of breast feeding was one variable in this study. By taking 25 and above month as a reference category, the odds of children being stunted has increased by 11%, 36.6% and 44.1% for less than 6 month, 6-12 month and 13-24 month breast feeding, respectively controlling for the other variables in the model. This shows it needs to be further investigation why this happen. Breast feed the child still now (AOR: 0.40; 95%CI: 0.20-0.78) is a significant effect with stunting [12].

Taking fully vaccinated as a reference category in vaccination status variable, even if the P-value was not significant the odds of being stunted has increased by 69.7% for not vaccinated children. Whereas the odds of being stunted has decreased by a factor of 0.556 partially vaccinated children controlling for the other variables in the model.

Postnatal cares were used as a one variable for stunting. The odds of not taking postnatal care being stunted have increased by 26.7% as compared to taking postnatal care. This shows clinical follow up was very essential to reduce children nutritional problem.

Taking children occurrence of Diharrea and fever before two week as reference category, the odds of children being stunted was decreased by a factor of 0.46 and 0.521 for no Diharrea and Fever, respectively controlling for the other variables in the model. This implies children who have Diharrea and Fever are more exposed to be stunted.

4. Conclusions

The aim of this study was to analyze the determinants of Stunting and Wasting among Under-five Children of Segen Area People and South Omo Zone, Ethiopia by using multivariate logistic regression model. 339 children are selected from 5 woreda using self-administered questionnaire. Among these 148 children are females and 191 are males. From 339 children under study, 35.4% of children are wasted and 54.9% are stunted. These shows there are a malnutrition problem in Segen Area People and South Omo Zone, Ethiopia.

Based on the finding of this study family religion, mothers' occupation except agriculture, mothers education level, family food source, source of drinking water (public tap), female children, child order except first order, duration of breast feeding and vaccination status are decreasing effect on wasting. Children whose mother does not attended ANC were increasing effect with wasting. Children who have fever before two week are more likely to expose to wasting than no fever.

Religion is highly important explanatory variable to reduce stunting. Likewise, mothers occupation except merchant, mothers education level except illiterate (illiterate mothers child are more exposed to be stunted than the other), female children, child order (second and third), vaccination status (partially and fully vaccinated), Diharrea and Fever are decreasing effect on stunting. But marital status and duration of breast feeding are an increasing effect on stunting.

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