# PREDICTORS OF CHILD STUNTING IN FITCHE TOWN, NORTH SHEWA ZONE, ETHIOPIA

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## ABSTRACT

Stunting is a well-known child health indicator for chronic malnutrition. The nutritional status of children is a good gauge for the nutritional well-being of the population, and it is, nowadays, one of the key issues in interrupting generational poverty transmissions as they bear the brunt of poverty. There has been scarcity of disaggregated survey to explore covariates of child stunting. This study attempted to identify socio-economic, demographic and other proximate factors associated with stunting of children under the age of five in Fitche town. The survey was cross- sectional, conducted using multistage sampling procedures to collect information from 160 children and caregivers. The anthropometric, descriptive and logistic analyses to determine the prevalence and identify covariates of child stunting were applied using Epi info and STATA software. Logistic analysis of the effects of selected child and maternal characteristics, child caring practices, and environmental health conditions on child stunting was done. Therefore, birth order, family size, maternal education, remittances, farm income, income from women employment and size of cultivated land were found to be the strongest predictors. However, the estimated coefficients of vaccine status of the child, Low Birth Weight, latrine facility in the house, morbidity status of the child, child birth interval, distance to the nearest health center, antenatal care visit of the mother and household's source of water indicated theoretically inconsistent and statistically insignificant effect on the likelihood of child stunting. The prevalence of child stunting was 45%, which is significantly higher than the regional and national averages. Among children who were stunted, 11.9 % were moderately stunted compared to 33.1% who were severely stunted. The proportion of stunted children for male was greater than female. There is a need to increase maternity care and education as this would make them amenable to health interventions that help improve not only their nutritional status and that of their child but also improve their income earning potential and food purchasing power. Addressing poverty may lead to improvements in the nutrition status of children as household economic status significantly determines nutritional status in the town.

**Key words:** child stunting, anthropometry, Epi info, logistic, Fitche, Ethiopia

## INTRODUCTION

Child malnutrition refers to an abnormal physiological condition caused by deficiencies, excesses, or imbalances in the energy, nutrients, or both necessary for an active, healthy life [1]. The term encompasses undernutrition, overnutrition, and micronutrient deficiencies. Although over nutrition is growing to be a problem via industrialization and change in feeding habit, malnutrition in developing countries implies undernutrition. The nutritional status of children under the age of five is considered as a good gauge for the nutritional well-being of the population. It has been shown that improved nutrition and health enhance growth of children to their fullest height and cognitive potential [2, 3]. In the long run, it leads to an increase in the strength of the labor force and thereby contributes positively for economic growth. On the other hand, malnutrition has also long been recognized as a cause and consequences of poverty [4, 5]. In a poor family, children are the most vulnerable victims. Malnourished children have higher risk of infection and disease, lower physical and cognitive potential, and experience reduced productivity that can be compromised with lower income earning potential and quality of life [6]. Impoverished children are good channels of poverty transmission to the next generation. When girls grow malnourished, they will be malnourished mothers more likely to have low birth weight babies, thus creating an endless cycle of poverty.

Ethiopia, the most vulnerable country in sub Saharan Africa [4], has an average of 40.4% (14.8 million) children under five years of age who are stunted. Approximately 2 out of 3 children have anemia, which is the highest rate in the region and the world [7]. There is a significant social and economic cost to individuals and countries affected by malnutrition. According to the Cost of Hunger in Ethiopia study, the total loss associated with child undernutrition was estimated to be 55.5 billion Ethiopian Birr (ETB), which is equivalent to 16.5 % of GDP every year [8]. It has also been revealed that nearly 5.6 million people in Ethiopia require emergency food assistance, 2.7 million children and lactating mothers require supplementary feeding, and 300,000 children under five years of age must be targeted for the treatment of severe acute malnutrition in 2017 [9].

Nutritional outcomes are the result of many principal determinates. In poor countries, multifaceted factors affect children nutritional status. Literature finds covariates of stunting in children under five to include poverty, food insecurity, inadequate child care and unhealthy environment, insufficient access to health services, parental illiteracy, inadequate feeding practices, large family size, non-exclusive breastfeeding, diarrhea, low birth weight, immunization status, broken family, repeated pregnancies, and poor access to improved water, sanitation and hygiene infrastructure which are the fundamental causes of child undernutrition [10].

Repeatedly, periods of food shortage and excessive mortality or both have been observed in Ethiopia. Most events have been concentrated geographically in two broad zones of the country. The first comprises the central and northern highlands, stretching from northern Shewa through Wello and Tigray, and the second is made up of the crescent of low-lying agro-pastoral lands ranging from Wello in the north, through Hararghe and Bale to Sidamo and Gamo Gofa in the south [11].This disproportionate strike by drought and famine, and subsequent high prevalence of poverty, food insecurity and malnutrition

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is closely related to high population pressure, poor agro ecological resource base and drought propensity [12].

Measurement of child stunting is one of the key indicators for monitoring the welfare of a population and measuring the impact of change in factors that affect the welfare of a population especially where regular demographic and health surveys are lacking. To reduce the problem, we need to understand its causes. Nonetheless, there has been scarcity of disaggregated survey to identify household level covariates at a particular time for decentralized decision making. This study has been done in Fitche town, which is part of the food deficit geographical zone in Ethiopia. Whilst there have been a few studies in other districts in Ethiopia, studies examining the status and determinants of child stunting in Fitche town is, at best, scanty. Thus, this study attempted to provide micro level empirical evidences and dealt with the following two questions: 1) what is the prevalence of stunting of children 0–59 months of age in the study area? 2) What are the key predictors of stunting among children 0–59 months of age in the study area? The study can serve as reference in priority setting and designing effective nutritional programs.

## RESEARCH METHODOLOGY

### Description of the study area
Fitche town is located in North Shewa zone of central Ethiopia 112 km away from Addis Ababa along the road to Bahir Dar. The town covers a total land area of 3,325.1 hectares. The town is divided into 4 kebele administrations. The population size of the town is expected to grow to about 45,730by the end of 2020. The average household size for the population of the town according to the data of Central Statistical Authority is 3.6[13]. The altitude of the town ranges from 2510 meters to 2972 meters above sea level. The annual average temperature ranges from $15^0c$ -$18^0c$, while the annual average rainfall varies between 1200-1400 mm. The rainfall in the area is characterized by its bi-modal distribution pattern.

Regarding infrastructure, Fitche town is supplied with piped water obtained from springs and bore holes. There are 13 springs spatially distributed in different parts of the town and one bore hole. The existing water coverage of the town on the basis of 20 liters per person per day is 68.33%. There are both public and private health institutions. The current capacity of electric power supply for the town is 1.5 megawatts, 67.7% of the total electric power requirement. The town does not have any alternative source of power. There is no solid waste disposal site, although the rapid urbanization necessitate in the town. Among the total 7498 housing units in the town about 37.3 % had no toilet facility.

### Sources of Data
A two- stage sampling procedure was implemented to draw observation units for this study. In the first stage, two of four kebeles were selected randomly in Fitche town. In the second stage, household heads, which have at least a child under five years of age in the selected Kebeles, were identified and a total of 160 households were randomly selected using probability proportional to size. The study applied a formula by Yamane [14] to determine the population size. A structured questionnaire was developed to

collect household characteristics, and interviews were conducted with mothers/care givers to obtain children's height, Mid- Upper Arm Circumference and weight. It was pre-tested on five respondents selected randomly and modifications were made before starting the actual survey. Height was measured with a measuring board made of hardwood in 0.1 cm graduations, with a movable head board and a foot board for a child to stand on. Measurements for children <24 months were taken as length with the child lying down on the board. Three trained undergraduate students were enumerators. Approval for the data collection was given by Fitche town Health Office and the study village administrators.

**Method of Data Analysis**
Anthropometry, descriptive statistics and econometric analysis were applied to meet the stated objectives. The indicator used to assess chronic malnutrition analysis was Height - for - Age (HAZ). The individual HAZ was derived from raw anthropometric data using Epi Info computing software. After the data collection and retrieval, the data were sorted out, edited, coded and analyzed using SPSS and STATA. Descriptive statistics such as percentages, means and standard deviations were obtained along with inferential statistics like Chi - squares and t - tests. Binary logit econometric model were also employed to identify major determinants of child stunting.

**Anthropometry Analysis**
To measure the prevalence of stunting under the age of five in the study area, Z- score value was applied. Mathematically,

$$Z - Score = \frac{X_i - X_r}{\delta_r}$$

Where; $X_i$ is an observed value for $i^{th}$ child in a target population; $X_r$ is median of the reference population; and $\delta_r$ is standard deviation of the reference population.

The HAZ index provides an indicator of linear growth retardation and cumulative growth deficits in children. The most commonly adopted cut-off point for all nutrition indicators is a Z-Score value of $-2\delta$. Children whose HAZ below $-2\delta$ from the median of the WHO reference population are considered short for their age (stunted), or chronically malnourished [15]. Children who are below $-3\delta$ are considered severely stunted.

For anthropometric indicators, plausibility checks were made during calculations of z-score using the ENA software, and hence, z-score below $-4\delta$ and above $4\delta$ were excluded from the analysis. This part of the plausibility report shows that the standard deviation is relatively high and therefore the rate of malnutrition is higher than it would be with a normal standard deviation.

**Descriptive Statistics**
Descriptive statistics were used to analyze socioeconomic and demographic variables, child and maternal characteristics, child caring practices and environmental health conditions. On this basis, mean and standard deviation were used. The Chi - square test was used for testing the significance of associations between the dummy explanatory

variables and child stunting. To analyze the significant differences between stunted and non stunted children due to continuous explanatory variables, the other inferential statistics, t test were applied.

**The Analytical Model**
When the dependent variable is binary or categorical, the analysis could be conducted using linear probability or logit or probit models. But, the results of linear probability model may generate predicted values less than zero or greater than one, which violate the basic principles of probability [16].

The measurement HAZ was calculated using the Child Growth Standards released by the World Health Organization in 2006. The dependent variable in this study is binary whereby the sample children were categorized into stunted ($y = 1$) and non-stunted ($y = 0$) on the basis of Z-score. Binary logit regression model is commonly recommended as an appropriate probability model in such situation. Many researchers have also used logit model for similar empirical analysis. Following Guajarati [17], the analysis of logistic regression model shows that changing an independent variable alters the probability that a given child becomes stunted, and helps to produce the probability of being non-stunted child which is mathematically specified as follows:

$$\prod(x) = E\left(Y = \frac{1}{X_i}\right) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}}$$

Where: e - is the base of the natural logarithm, $X_i$ is the $i^{th}$ explanatory variable, $P_i$ is the probability that an individual will make a certain choice given $X_i$, $\alpha$ and $\beta$ – are regression parameters to be estimated. The probability that a child was non stunted would be $(1 - \prod(x))$.

$$1 - \prod(x) = \frac{1}{1 + e^{z_i}}$$

Where; $\prod(x)$ is a probability of being non stunt ranging from 0 to 1 and $Z_i$ is a function of n explanatory variables ($X_i$) which is also expressed as: $Z_i = \alpha + \beta_{+i} X_i$

The Exp (B) or Odds ratio was determined from the logistic regression. The probability for a child to be stunted was expressed as,

$$\frac{\prod(x)}{1 - \prod(x)} = \frac{1 + e^{z_i}}{1 + e^{-z_i}} = e^{z_i}$$

If the disturbance term is taken into account, the logit model becomes

$$Z_i = \alpha + \sum \beta_i X_i + U_i$$

Before estimating the model, it was necessary to check the existence of multicollinearity among the hypothesized explanatory variables.

Variance Inflation Factor (VIF) technique was used to detect the problem of multi-collinearity for continuous explanatory variables [16]. Each selected continuous variable is regressed on the other, so that the coefficient of determination ($R^2$) would be constructed. If an approximate linear relationship exists among explanatory variables, it will result in a large value for $R^2$ in at least one of the test represents. A variable is said to be highly collinear, if $R^2$ exceeds 0.9 or VIF exceeds 10[18]. Variance Inflation Factor is expressed as:

$$VIF = \frac{1}{1 - R^2}$$

Where: VIF is variance inflation factor and $R^2$ is coefficient of determination.

Similarly, there may also be an interaction between discrete variables, which can lead to the problem of multicollinearity or strong association. To detect this, contingency coefficients were computed from the survey data. The values of contingency coefficient range between 0 and 1, zero indicating no association between the variables and values close to 1 indicating a high degree of association, which means high degree of multicollinearity. The contingency coefficients were calculated as follows:

$$C = \sqrt{\frac{\chi^2}{N + \chi^2}}$$

Where: C is the contingency, $\chi^2$ is chi-square test and N is total sample size.

For comparing maximum likelihood models, the two popular measures, AIC and the BIC were employed. Akaike Information criterion (AIC) and Bayesian information criterion (BIC) are defined as

AIC = -2xln (likelihood) + 2xK
BIC = -2xln (likelihood) + ln (N) x K

Where: K is number of parameters estimated and N is number of observations.

Akaike Information criterion (AIC) and Bayesian information criterion (BIC) can be viewed as measures that combine fit and complexity. Fit is measured negatively by -2xln (likelihood); the larger the value, the worse the fit. Complexity is measured positively, either by 2 x K (AIC) or ln (N) x K (BIC).

Receiver Operating Characteristics curve is a plot of the true positive rate against the false positive rate for different possible cut off points of a diagnostic test. In a ROC curve, the true positive rate (sensitivity) was plotted in function of the false positive rate (100 - specificity) for different cut off points. Each point on the curve represents a sensitivity/specificity pair corresponding to a particular decision threshold. The area under the ROC curve should be between 0 and 1 and measures the predictive accuracy of a model. The closer the curve comes to the 45 degree diagonal of the ROC space, the less accurate the model.

**Variables and Hypothesis**

The main outcome variable in this study was HAZ or child stunting as determined by anthropometric measurement of height and age (1 if HAZ value of the child is less than -3δ, 0 otherwise). The predictor variables considered as potential determinants of child stunting were grouped into1). Socio-economic and demographic variables; such as family size, remittances, farm income, size of cultivated land, and income from women employment (autonomy in decision making on use of money). 2). Child characteristics: birth order of the child, birth interval of the child and low birth weight. 3). Child caring practice; vaccination status of the child and morbidity status of the child. 4) Maternal characteristics; maternal education and antenatal care visit of the mother. 5). Environmental health condition; latrine facility in the house, household source of water and distance to the nearest health center [2, 19, 20, 21, 22, 23]. Hypotheses on the explanatory variables have been guided by theory and local knowledge, apart from numerous previous empirical studies.

**RESULTS AND DISCUSSION**

**Prevalence of Child Stunting**

Table 1 provides summary of nutritional status of children under the age of five, showing 45% (72) and 55% (88) of children were stunted and non-stunted, respectively. Among children who were stunted, 11.9 % were moderately stunted compared to 33.1% who were severely stunted. The prevalence of stunting for male and female children was 52% (39) and 38.8% (33), respectively, showing a significance difference between prevalence of stunting in boys and girls at less than 10% level of probability (Table 5). However, a study done in Botswana revealed that the prevalence of child stunting was significantly higher among boys than girls [24]. The result of this study revealed that the prevalence of stunting in Fitche was lower as compared with a study conducted in the Abote district (47.6%), which is higher than the Oromia region (41.4%) and national average in 2014 (40.4%) for stunting [25, 26, 27].
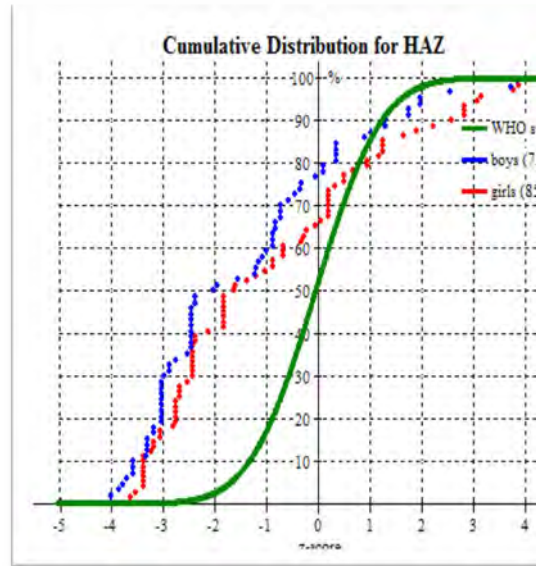
As shown in Figure 1, the children's height-for-age average deviation, from the healthy and well-nourished standard reference children of the same age for male and female is -1.14±2.03. The mean age of the children in the study area was 24.5±15.3 months.
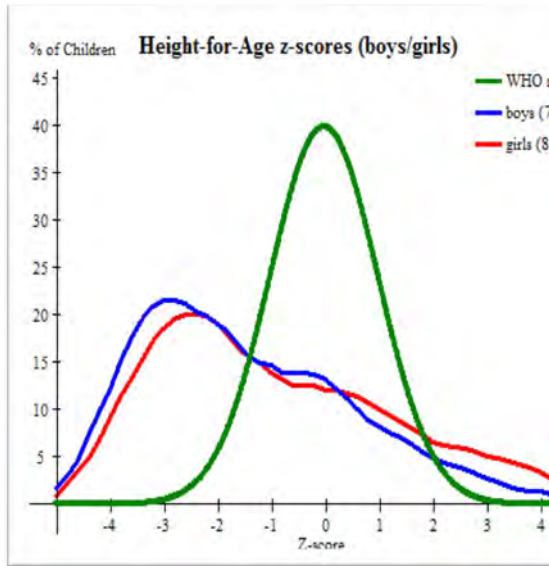
**Figure 1: HAZ of children as compared to the standard reference population by sex with normal distribution**



**Figure 2: Cumulative distribution of HAZ of children as compared to the standard reference population by sex**

The results show that the level of stunting, in children of 6 - 17, 18 - 29 and 30 - 41 months of age were 65.6%, 46.5 % and 52.7%, respectively while reaching 33.3% and 16 % for 42 - 53 and 54 - 59 months old children, respectively. Figure 4 and table 3 on the other hand portrayed that the proportion of stunting for the younger age cohort (6 - 17 months) was 4.1 times compared with children in the older age cohort (42 - 53 months). Children in the age cohort (6 - 17 months) were also approximately twice (1.97 times) more likely to face stunting than the older age groups (54 - 59 months) controlling for the effect of the other factors. Overall, the chance of stunting increases from the youngest age cohort (6 - 17 months) to the older (54 - 59 months) and remains relatively similar for children aged (17 – 29months), (30-41months) and (42 – 53months).
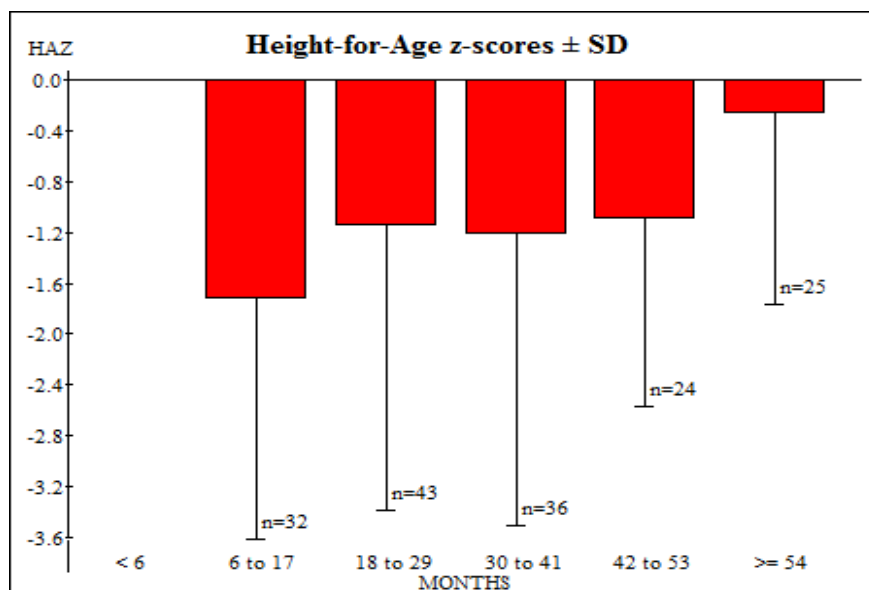


**Figure 4: Height-for-Age z-scores (HAZ) ± SD**

**Descriptive statistics**

For the six continuous explanatory variables, independent t-tests results significant mean difference between stunted and non-stunted children with respect to remittances, farm income, income from maternal employment and size of cultivated land (Table 4). However, livestock ownership and distance to health center were found to have statistically insignificant difference between the two groups. This indicated that income helps to purchase basic food items and also nourished and enriched foods. Therefore, this study confirmed that income plays a major role to the welfare of children since it is a major source of expenditure for purchasing life sustaining food, luxuries and quality food. Land and its economic benefits are significant to measure child malnutrition. In this study, land affects child nutrition in the sense that families with land are capable of producing enough food, or income from crops, which minimizes susceptibility to malnutrition.

A chi-square test for the discrete variables indicated that greater proportion of stunted children were members of illiterate mothers (78.7%) and mother that did not attended antenatal care visit during pregnancy (96.0%) significant at less than 1% level of probability. Vaccination status of the child also minimized malnutrition. This is manifested with the significant differences between stunted and non-stunted children. Nearly equal proportion of children among the non-stunted, and 10.7 % of the stunted children did not practice vaccination. Additionally, size at birth and sex of the child were important indicator of a child's nutritional status at less than 10% level of significance, and hence affected likelihood that a child is chronically malnourished [28]. It is also evidenced that stunting is more common among children who were very small at birth [15] (Table 5).

**Econometric Analysis**

The VIF and C tests revealed that the values corresponding to each continuous explanatory variable were less than 10 and to each dummy variable were less than 0.75 - the cutoff point - implying that there was no collinearity problem in the data. The model was statistically significant (P < 0.001). The model predicted 86.7 % stunting groupsand87.1 % of the non-stunted groups were correctly identified (specificity).

The area under the ROC curve was found to be 0.9431 (Figure 5). Since the area under the curve is more than 0.5, and the closer the curve follows the left hand border and then the top border of the ROC space, the model is found to acceptable. On the other hand, as can be displayed on table 2, since the model had smaller value of the information criterion, it was considered to be better fit.
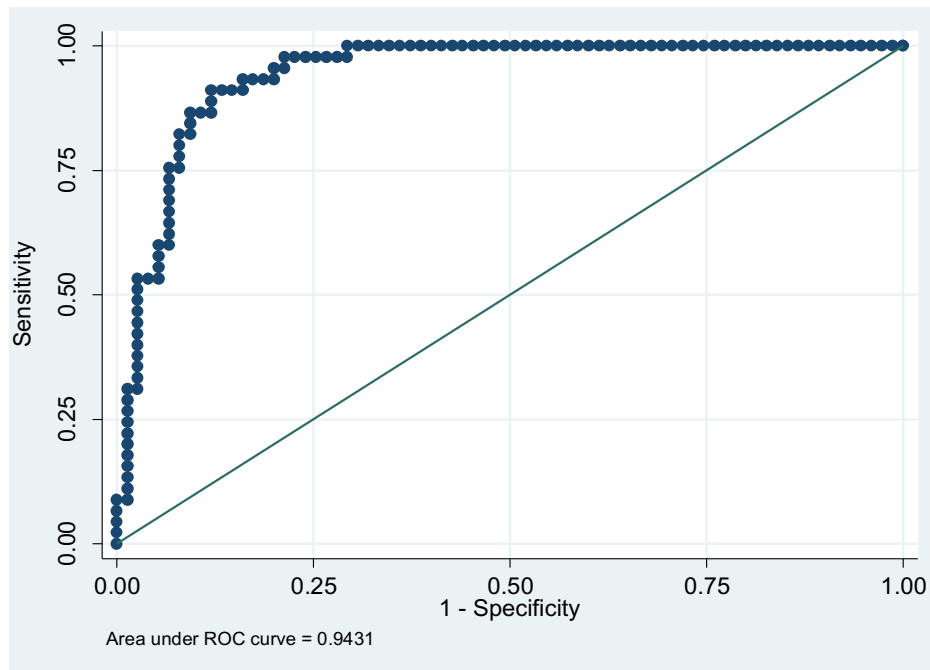
**Figure 5: Receiver Operating Characteristics (ROC) curve**

The sigma plot depicts sensitivity as a function of specificity illustrates a rating's trade-off between true positives and false negatives. A higher value of sensitivity for a given value of specificity indicates better performance. The area under the ROC curve (AUC) is a common metric for evaluating a rating's performance. If the rating has no connection to the true class, the expected AUC would be 0.5. The crossover is the optimal decision threshold where the maximum numbers of cases are correctly identified as positive or negative. Therefore, the sensitivity (percent correctly predicted stunted) and specificity (percent correctly predicted non stunted) are more than 90 percent (Figure 6).
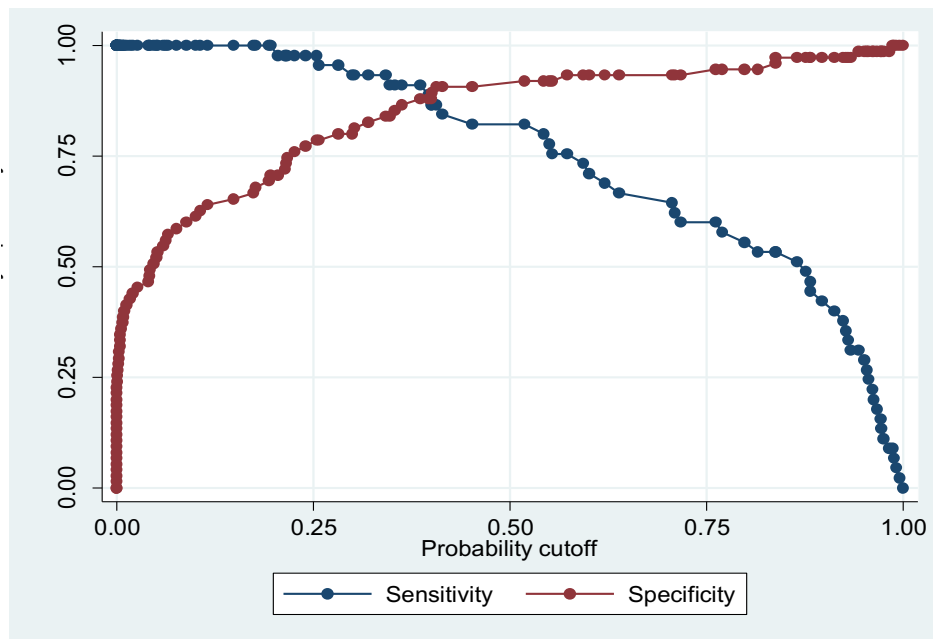
**Figure 6: Sigma plot of sensitivity and specificity**

Of the fifteen variables entered in the model, birth order, remittance, farm income and income from mother employment (at P <0.01); cultivated land size and distance to nearest health center (at P <0.05) and maternal education (at P <0.1) level of probability were found to be significant. In light of the summarized model results (Table 6), possible explanations for each significant independent variable are given here-under.

Birth order of the child was a good predictor of child stunting for a country with chronic food insecurity and high fertility. The result revealed that child stunting was significantly affected with birth order (at P <0.01). The marginal effect of the variable indicated that with an increase in birth order by a unit, the probability of the child to be stunted increased by 6.3%. It is expected that parents give less attention to older children when they give birth to a new child who needs much attention and care. Children of first birth order were found to be at a significantly higher risk of stunting than children of higher birth. This could be due to mothers' low level of experience at first delivery in the area of childcare and feeding, which are important components of improved nutrition. Close spacing has a negative health effect on the previous child, who may be prematurely weaned if the mother becomes pregnant again too early. It is consistent with the findings of research which were held in Ethiopia and other developing countries [28, 29].

Contrary to the expectation, the coefficient of family size was found to be negative and statistically significant for HAZ (at P <0.05). In other words, a child in a household with large size of the family was relatively less stunted than a child in a household with few members, ceteris paribus. The marginal effect of size of the family indicated that the probability of the child being stunted decreased by 6.2% with an increase in household size by one adult equivalent unit. There might be three justifications for this effect. One, it might be because children from a large family size can benefit from economies of scale both in time available for childcare and in expenditure. The second was existence of more

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economically active than non-active members. The last, children could better be raised due to accumulated fund of parental know-how. This result actually is consistent with many findings [22].

Maternal education was significantly and inversely related to child stunting (at P <0.01), indicating that households with a better educated mother are less likely to have stunted children. Controlling the effect of other factors, the risk of being exposed to stunting would be curtailed by 23.4 % with the occurrence of maternal education. The possible explanation for this could be, as mothers get educated, they are more at ease to adapt and utilize new information available through health education and mass media. Various studies have concluded that maternal education is a key element in improving children's nutritional status [20, 21, 30]. It has also been revealed that more than 4 in 10 children born to mothers with no education (42 %) are stunted compared with 18 percent of children whose mothers have more than a secondary education [15]. This finding is consistent with a study in Bangladesh implying that efforts for redressing child stunting issues should focus on development outcomes such as maternal income and maternal education that do not compromise important child care practices such as breastfeeding [24].

The coefficient of remittance was found to be negative and statistically significant (at P <0.01). The marginal effect indicates that if remittances either in cash or in kind increases, stunting would be minimized by 0.03%. As household income attributable to remittance rises, investment on children's human capital is likely to increase with concomitant reduction in neonatal and infant mortality, illness and low birth weight, on young children. Remittances from economic migration have the power to supplement basic household expenditures (food, clothing, medicine) and improve human capital development for many left behind children. Moreover, remittance can improve the standard of living and reduce poverty and malnutrition.

As hypothesized, the study found evidence that child stunting is determined by farm income. Farm income has negative and significant relationship with that of child stunting (at P <0.01). The marginal effect in favor of farm income revealed that an increment of 100 Ethiopian birr (ETB) in income minimize child stunting by 4%. Children from household with high farm income were less likely to be stunted than from low farm income households. A similar finding was reported by others [25, 31]. Smallholder agriculture, providing largest proportion of food consumed worldwide, represents enormous and untapped sector to combat malnutrition [32]. There are multiple pathways through which farming addresses nutrition. This argument is backed up by many stylized facts, agriculture supposedly have strong multiplier effects; as source of food, a source of income, driver of food prices, moderator of women's time use and decision making power and moderator of food markets [33]. Households with agricultural productivity might fulfill dietary diversity and quality of diet in terms of the basic calorie consumption. It can be used to diversify household nutritional intake through purchases of food grown by others. It also allows households to invest in their own health, allowing for the purchase of essential nonfood items; health care, sanitation, shelter and fuel for a healthy and productive life.

As can be hypothesized, women's employment enhanced the household's accessibility to income, or positively affects the nutritional status of children, via reducing mother's time for childcare significant (at P <0.01). This study revealed that mothers of the less malnourished children worked outside their home. The possible reason for this is income earned by mothers through employment raise a household's demand for food. This may be because the time allocated to earning income might not be at the expense of time spent in feeding and caring for children. The marginal effect of this variable revealed that the probability of the child being stunted, other things remaining constant, decreased by 15% as income of employed mothers increases by 100 ETB. This study found that mothers with better economic autonomy and freedom to travel to the marketplace were less likely to have stunted children consistent with many studies [34]. Mothers' employment, childcare strategies, and nutritional status might be rendered into increased energy intake and improved health status of children. Since the majority of mothers in Ethiopia work in the informal sector and in lower paid jobs, the amount of income for these mothers is low. However, employed mothers may have greater awareness in childcare that directly impacts the nutritional status of children of employed mothers.

The coefficient associated with size of cultivated land, as anticipated and consistent with previous studies [22], was found to be negative and significant (at P <0.01). In this study, land has positive impact on reducing child stunting. The probability of the child to be stunted, other things being constant, increased by 15.4%, with one hectare increase in size of cultivated land. Children from household with large farm land are better nourished than those with small farm land. The possible justification was that households with more land have a better production in subsistent agriculture.

**CONCLUSION**

This study examined the prevalence of stunting and associated factors among 6-59 months children. It finds evidence that stunting among children under five years of age in Fitche town is sever than the regional and national averages, thus needs serious attention. The empirical analysis on the other hand, revealed that such household characteristics as maternal education, cash remittances, farm income, income from mothers' employment and size of cultivated land, and child caring and maternal characteristics as birth order were found to be significant covariates of child stunting. It underscores key determinants of child stunting as complex and interrelated, all rounded interventions for improving the severity, while ultimately alleviating the problem. Though model results are broadly consistent with what has previously been done in other studies, it yields findings that would seemingly be valuable in providing disaggregated malnutrition profile.

Complexity of the problem demands multifaceted solutions. Fighting child stunting in a comprehensive way requires adopting approaches that combine short and long-term interventions, as well as fostering linkages between curative and preventive aspects of humanitarian and development interventions. Escalating cases of child stunting needs public eye and so healthcare providers as well as the government are taking the necessary steps to improve the nutrition status of children in Ethiopia. However, mothers need more access to skilled support from health extension workers to help them initiate and sustain
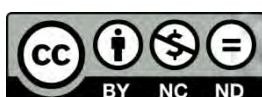
appropriate feeding practices as well as to prevent and overcome difficulties. To provide good nutrition for pregnant women and lactating mothers, health centers should nearly be accessible. Furthermore, great attention has to be given in expanding as much birth intervals as possible via family planning services. To enhance child care, feeding practices and household management in the area, and thus reducing child stunting, maternity care and maternal education serves as effective conduit to target fighting on the blight of child stunting. Generally, addressing poverty may lead to improvements in the nutrition status of children as household economic status significantly determines nutritional status in the town.

**Table 1: Prevalence of stunting based on height-for-age z-scores (HAZ) and by sex**

|  | All | Boys | Girls |
|---|---|---|---|
|  | n = 160 | n₁ = 75 | n₂ = 85 |
| Prevalence of stunting (<-2 z-score) | (72) 45.0 % | (37) 49.3 % | (35) 41.2 % |
| Prevalence of moderate stunting (<-2 z-score and ≥-3 z-score) | (30) 18.8 % | (16) 21.3 % | (14) 16.5 % |
| Prevalence of severe stunting (<-3 z-score) | (42) 26.3 % | (21) 28.0 % | (21) 24.7 % |

***p < .01, **p < .05, *p < .1

**Table 2: Akaike's information criterion and Bayesian information criterion**

| Model | Obs | ll(null) | ll(model) | df | AIC | BIC |
|---|---|---|---|---|---|---|
|  | 160 | -79.38759 | -36.41426 | 13 | 98.82852 | 135.0659 |

**Table 3: Prevalence of stunting by age based on height-for-age z-scores**

| Age(months) | Total no. | Severe stunting (<-3 z−score) | | Moderate stunting (3 ≤ z−score <2) | | Normal (z−score ≥ -2) | |
|---|---|---|---|---|---|---|---|
|  |  | No. | % | No. | % | No. | % |
| 6-17 | 32 | 13 | 40.6 | 8 | 25.0 | 11 | 34.4 |
| 18-29 | 43 | 13 | 30.2 | 7 | 16.3 | 23 | 53.5 |
| 30-41 | 36 | 10 | 27.8 | 9 | 25.0 | 17 | 47.2 |
| 42-53 | 24 | 4 | 16.7 | 4 | 16.7 | 16 | 66.7 |
| 54-59 | 25 | 2 | 8.0 | 2 | 8.0 | 21 | 84.0 |
| Total | 160 | 42 | 26.3 | 30 | 18.8 | 88 | 55.0 |

***p < .01, **p < .05, *p < .1

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**Table 4: Descriptive statistics for continuous variables**

| Variables | Stunted (N=72) | | Non-stunted (N=88) | | Total (N=160) | | t-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | |
| Remittances | 256.00 | 376.05 | 777.24 | 702.04 | 1033.24 | 1078.09 | - 5.743*** |
| Farm income | 906.5 | 528.09 | 1686.63 | 1264.93 | 2593.18 | 1793.02 | - 4.971*** |
| Employment income of mothers | 82.5 | 146.80 | 338.72 | 348.68 | 421.26 | 495.48 | 5.916*** |
| Family size | 2.8 | 2.11 | 2.37 | 1.61 | 5.20 | 3.72 | -1.524 |
| Size of cultivated land | 1.79 | 1.04 | 2.65 | 1.52 | 4.45 | 2.57 | - 4.115*** |
| Distance to health center | 2.62 | 1.80 | 3.00 | 1.94 | 5.62 | 3.75 | -1.282 |

***p < .01, **p < .05, *p < .1

**Table 5: Descriptive statistics for discrete variables**

| Variables | | Stunted (N=72) | | Non-stunted (N=88) | | Chi-square |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| Birth order of the child | higher birth order + 5 | 36 | 48 | 39 | 48.88 | 0.072 |
| | Lower birth order 2 – 3 | 39 | 52 | 46 | 54.11 | |
| Maternal education | Illiterate | 59 | 78.7 | 22 | 25.9 | 44.412*** |
| | Literate | 16 | 21.3 | 63 | 74.1 | |
| Morbidity status of the child | Suffered by disease | 24 | 32 | 26 | 30.59 | 0.037 |
| | Not suffered by disease | 51 | 68 | 59 | 69.4 | |
| Latrine facility in the house | No | 29 | 38.67 | 32 | 37.64 | 0.018 |
| | Yes | 46 | 61.33 | 53 | 62.35 | |
| Household source of water | Unsafe | 9 | 12 | 16 | 18.82 | 1.407 |
| | Safe | 66 | 88 | 69 | 81.17 | |
| Antenatal care visit of mothers | Yes | 3 | 4.0 | 48 | 56.5 | 33.025*** |
| | No | 72 | 96.0 | 37 | 43.5 | |
| Vaccine status of the child | No | 67 | 89.3 | 42 | 49.4 | 29.24*** |
| | Yes | 8 | 10.7 | 43 | 50.6 | |
| Low birth weight baby | Yes | 52 | 69.33 | 48 | 54.47 | 2.813* |
| | No | 23 | 30.67 | 37 | 43.52 | |
| Sex of the child | Male | 39 | 52.00 | 46 | 54.12 | 0.072* |
| | Female | 36 | 48.00 | 39 | 45.88 | |

***p < .01, **p < .05, *p < .1

**Table 6: Logit model estimate of child stunting**

| Stunting | Coefficient | SE | Marginal effect |
|---|---|---|---|
| Birth order of the child | 2.56472*** | 0.8002674 | 0.0629333 |
| Family size in adult equivalent | -0.3364241** | 0.1709549 | -0.062077 |
| Vaccine status of the child | -0.0675341 | 0.6381384 | -0.0125122 |
| Low Birth weight | -0.4557264 | 0.6130238 | -0.0815724 |
| Maternal employment income | -0.0084378*** | 0.0018194 | -0.0015569 |
| Latrine facility in the house | 0.3431199 | 0.609295 | -0.1741767 |
| Morbidity status of the child | 0.5870204 | 0.6254718 | 0.1020915 |
| Maternal education | -1.276933* | 0.7139985 | -0.2337684 |
| Child birth interval | -0.1580426 | 0.5979436 | -0.0291441 |
| Remittances | -0.0021226*** | 0.0006113 | -0.0003917 |
| Farm income | -0.0023959*** | 0.0007148 | -0.0004421 |
| Distance to nearest health center | -0.0772768 | 0.1623835 | -0.0142591 |
| Antenatal care visit of the mother | -0.6241118 | 0.6416443 | 0.528445 |
| Size of cultivated land | -0.8366487** | 0.3499186 | -0.1543785 |
| Household's source of water | -0.8344736 | 0.9410534 | -0.1078933 |
| _cons | 8.500741 | 2.183217 | |
| Number of obs   = 160 | | Prob> chi$^2$ | = 0.0000 |
| LR chi$^2$(15)     = 133.08 | | Pseudo R$^2$ | = 0.6017 |
| Hosmer and Lemeshow test = 3.281 | | | |
| -2Log likelihood =  88.098 | | | |

***$p < .01$, **$p < .05$, *$p < .1$

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