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The Status of Young Children's Nutrition Security in Rural Area of Northwest Ethiopia

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ABSTRACT

Background: Nutrition security is a vital component of growth and development in a nation. However, dietary diversity and availability of healthy food are serious challenges to many local communities in Ethiopia. The objective of the study was to identify the status and the determinants of nutrition security of school-age children in Northwest Ethiopia. **Methods:** Primary data were collected and analyzed using a binary logistic regression model to determine the significance of nutrition security odds ratio of 12 variables. **Results:** The results revealed that around 55.4% of school-age children were nutritionally insecure and underweight, and 44.6% were stunted. The significant determinants of nutrition security in the study area were milk consumption, healthy eating habit, fruits and vegetables consumption, educational status of the guardian, meat consumption, and the child's place of residence. **Conclusion:** The findings of the study showed the need for nutrition education of the children and their guardians, and the need for accessibility of diverse and nutritious food products to help the school-age children with acute wasting and stunting problems they are facing.

Keywords: *Recommended dietary allowances; Growth disorders; Malnutrition; School age population; Eating behavior.*

Introduction

Two billion people in the world suffer from moderate or severe food insecurity, of which 675 million are in Africa (Food and Agriculture Organization, 2020). Nutrition insecurity is different from food insecurity because, in addition to lack of dietary adequacy, it includes inadequate caregiving practices, health, and hygiene (Food and Agriculture Organization, 2020), which are serious problems in Ethiopia.

FAO defines nutrition security as the presence of secure access to an appropriately nutritious diet (dietary adequacy) along with a sanitary environment and adequate health services and care which ensures a healthy and active life for all household members (Food and Agriculture Organization, 2020). Dietary diversity, defined as the total number of food groups consumed during a given period of time, is a reliable indicator of dietary adequacy among children (Zhao *et al.*, 2017).

Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or

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nutrients; and it addresses three groups of conditions (World Health Organization, 2021). These are: (1) undernutrition, which includes stunting (low height-for-age), wasting (low weight-for-height), and underweight (low weight-for-age); (2) micronutrient-related malnutrition, which includes micronutrient deficiencies (lack of important vitamins and minerals) or micronutrient excess; and (3) overweight, which consists of obesity, and diet-related noncommunicable diseases (such as heart disease, stroke, diabetes and some types of cancers). The first condition is the most serious one and the third condition is the least serious condition in Ethiopia.

Undernutrition has major implications for children's physical growth and cognitive development (Blankenship *et al.*, 2020). There are different types of undernutrition. (i) Chronic undernutrition (stunting) is generally an indicator of chronic (long-term) insufficient energy, protein, or micronutrient intake, which results in a child being very short for his/her age. Stunting often goes unrecognized in communities where short stature is so common that it is considered normal (De Onis and Branca, 2016). In Ethiopia, childhood stunting varies from region to region, with Addis Ababa having the lowest (15%) stunting rate and other regions of the country having a rate of between 41% and 46% (Takele *et al.*, 2019). Low household dietary diversity is one of the significant risk factors for child stunting in Ethiopia (Lee *et al.*, 2022). National stunting prevalence improved from 51% in 2000 to 32% in 2016 (Tasic *et al.*, 2020). However, this (32%) is still higher than the 22% rate of stunted children under the age of 5 globally (UNICEF and WHO, 2017), suggesting that more work needs to be done to reduce stunting in Ethiopia. A study by (Bakhtsiyarava and Grace, 2021) showed that increasing farm production diversity is a viable strategy to improve child nutrition in Ethiopia.

(ii) Acute undernutrition (wasting) is a symptom of recent periods of acute food insecurity, inadequate food intake, or chronic infectious diseases that leads to rapid weight loss or failure to regain weight resulting in a child having low weight for his/her height. The prevalence of wasting in children under the age of 5 is high (9.9%) in Ethiopia (Central Statistical Agency (CSA), 2017).

(iii) Underweight refers to a situation when a child's weight is less than what it should be according to his/her age. A child who is underweight may be stunted, wasted, or both (WHO, 2021). According to (Central Statistical Agency (CSA), 2017), 24% of the children in Ethiopia are underweight.

Micronutrient deficiencies, which are also called "hidden hunger" (Stein and Qaim, 2007), are specific nutritional disorders occurring when the body does not receive sufficient amounts of essential vitamins or minerals. This is due to either insufficient intake from diet, insufficient absorption, suboptimal utilization of micronutrients by body, or a combination of them. In Ethiopia, micronutrient deficiencies and associated morbidity and mortality are high compared to that of Sub-Saharan Africa and other parts of the world (Hamid Yimam *et al.*, 2020). Specifically, between 2005 and 2015, the prevalence of anemia, iron deficiency, iron deficiency anemia, vitamin A deficiency, and zinc deficiency in Ethiopia among children under the age of 5 were 42%, 18%, 9%, 25%, and 35%; and for children between the ages of 5 and 19, the rates were 26%, 9%, 4%, 11%, and 36%, respectively (Harika *et al.*, 2017).

Overweight and obesity refer to when a person who is too heavy for his/her height due to abnormal or excessive fat accumulation, which can impair health. Overweight and obesity result from an imbalance between the energy consumed (too much) and the energy expended (too little), and engagement in less physical activity (World Health Organization, 2021).

Although nutrition is a very critical component for the overall development of children, there is no empirical study on the nutritional status of young children, determinants of nutrition security, and its diversity in Northwest Ethiopia. Therefore, this study is conducted to determine the factors regarding nutrition security of school-age children

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in Northwest Ethiopia using a binary logistic regression model. The research questions of the study are the following: (1) What is the nutrition security status of young children? (2) What are the determinants of nutrition security status of young children?

Materials and Methods

Sampling method and sample size: Stratified random sampling, a probability sampling method, was used to select samples from the population of school-aged children (6 to 14 years old) from Agew Awi zone of Amhara region in Northwest Ethiopia. The woredas (equivalent to county) of Agew Awi zone were stratified to three ecological zones: Kola (lowland: <1500 m.a.s.l), Woina Dega (midland: 1500-2300 m.a.s.l.), and Dega (highland: >2300 m.a.s.l.), and one woreda was selected randomly from each ecological zone. The sample size (n=177) was determined using the formula in (Yamane, 1967). Then, the sample size for each woreda (Banjia, Jawi, and Dangila) was allocated proportionally as n_1=50, n_2=50, and n_3=77, respectively.

Inclusion and exclusion criteria: The inclusion criteria were 6 to 14 year-old children whose parents gave consent to participate in the study. The exclusion criteria were the children under 6 or over 14; children between 6 and 14 whose parents disagreed to participation.

Food consumption pattern dietary assessment data collection: dietary diversity score (DDS) and food consumption pattern data were measured using a 24-h dietary recall and a modified version of Helen Keller International Food Frequency Questionnaire (FFQ), respectively. FFQ questionnaires containing commonly consumed food items in the study area were grouped into 7 groups of meat products, grain, fruits, milk, vegetables, oil, and iodized salt (iodine).

Ethical cosiderations: The study followed proper ethics regulations, and informed consent was obtained from the parents/guardians of the selected children. The protection of the participants was ensured by adhering to the principles of confidentiality, voluntary participation, and the right to withdraw. All the participants received both oral and written information about the study.

Data analysis: To determine the significance of the relationship between each of the 7 categories and nutritional status, Chi-square test (χ^2) of independence was conducted. Binary Logistic regression model with meaningful interpretation when the dependent variable is a dichotomous outcome (Gujarati, 1998), was used to determine the significance of each continuous/categorical variable regarding the qualitative dichotomous dependent variable. Following (Gujarati, 1998), the binary Logistic model for the relationship between the probability of the dependent dichotomous variable and various independent variables was specified as:

$$P_i = E(Y = 1/x_i) = 1/(1 + e^{-(\beta_i + \beta_1 x_i)} \quad \ldots (1)$$

For ease of exhibition, this was written as:

$$P_i = 1/(1 + e^{-Z_i}) = e^{Z_i}/(1 + e^{Z_i}) \quad \ldots (2)$$

Where P_i was the probability that the i^{th} child was nutritionally secure and its value ranged from 0 to 1, and it was nonlinearly related to Z_i.

Z_i was a function of k independent variables:

$$Z_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki} \quad . (3)$$

Where x_1, x_2, …, x_k were independent variables; β_0 was the intercept; and β_1, β_2, …. β_k were the Logit parameters (coefficients) of the model.

Since P_i was the probability of nutrition status of a child being secured, $(1 - P_i)$ was the probability of the nutritional status of the child who was not secured, which was written as:

$$1 - P_i = 1/(1 + e^{Z_i}) \quad (4)$$

Thus, the expression $P_i/(1 - P_i)$ was known as the odds ratio, which was written as;

$$P_i/(1 - P_i) = [(e^{Z_i}/1 + e^{Z_i})/(1/1 + e^{Z_i})] = e^{Z_i} \quad (5)$$

By taking the natural log of equation (5),

$$L_i = \ln(P_i/1 - P_i) = Z_i \ldots\ldots \quad (6)$$ was obtained, where L_i was the log of the odds ratio, which was linear. Then, by introducing the error term (U_i), the theoretical Logistic regression model was obtained:

$$Z_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots\ldots + \beta_k x_{ki} + U_i \quad \ldots (7)$$

Anthropometric measurements (weight and length/height) and dietary assessment of each child were measured. Body mass index (BMI) calculated as weight (kg) divided by height (m) squared, is an index of weight-for-height commonly used to

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classify underweight, overweight, and obesity. The ranges of BMI are: BMI<17.0, indicating moderate or severe underweight, 17.0≤BMI<18.5 showing underweight status, 18.5≤BMI 24.9, normal weight, 25.0≤BMI 30.0, indicates being overweight, and BMI≥30.0 suggests obesity. A child is considered stunted if the height-for-age Z score is below −2 SD of the 2006 WHO growth reference, and severely stunted if the Z score is below −3 SD (World Health Organization, 2006). The collected data were analyzed using STATA (Version 16) software.

Results

Descriptive statistics and test of independence results: According to the BMI range, percentages of the underweight or wasted school-age children in Banjia, Jawi, and Dangila woreda were 60%, 56%, and 52%, respectively. For all the three woredas that represent Agew Awi zone, 55.4% of them were underweight or wasted, and 44.6% were stunted. The participants responded that the lack of access to healthy food (36.7%), healthy eating habit (31.6%), production problems (23.2%), lack of awareness (7.9%), and religion (0.6%) were the primary reasons for their nutrition insecurity. Among the school-age children, 39.6% did not go to school, and 58.7% had no milk consumption habit even once in six months; among them, 45.8% were nutritionally insecure. Moreover, 74% had no access to fruits and vegetables even once in six months, 57.63% of whom were nutritionally insecure.

The results regarding χ^2 test of independence between the categorical variables and nutrition security status are shown in **Table 1**. Accordingly, there was a significant (P<0.001) relationship between milk consumption and nutrition security. The children who consumed milk were 1.7 times more nutritionally secured than those who did not consume milk; only 28% of them were nutritionally secured. The relationship between healthy eating habits and nutrition security was also highly significant, and those with healthy eating habit were 9.6 times more were nutritionally secured, while the participants without a healthy eating habit, only 20% were nutritionally secured. The children who consumed fruits and vegetables were 6.7 times were more nutritionally secured, but among those who did not have fruits and vegetables, only 28% benefited from nutrition security. The relationship between educational status of the guardian or caregiver of the child and nutrition security is marginally significant (P=0.072), and approximately, 51% of the children with literate guardians were nutritionally secured, while 31% of the children with illiterate guardians enjoyed nutrition security. Consumption of meat products was also marginally significant which was related to nutrition security status, where the children consuming meat products were 1.17 times more nutritionally secured; however, among those who did not consume meat products, only 57% had nutrition security. The relationship between the sex of the child and nutrition security, and between woreda and nutrition security were not significant (**Table 1**).

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Table 1. Frequency distribution of food security status in term of according to categorical variables.

Variables	Nutrition security status		P-value[a]
	Secure	Insecure	
Sex of the respondent			0.52
Male	18.64	32.2	
Female	20.34	28.81	
Educational status of the guardian			0.07
Literate	20.34	40.11	
Illiterate	18.64	60.02	
Milk consumption of the child			<0.001
Yes	25.99	15.25	
No	12.99	45.76	
Healthy eating habit of the child			<0.001
Yes	27.12	2.82	
No	11.86	58.19	
Fruit and vegetable consumption of the child			<0.001
Yes	22.6	3.39	
No	16.38	57.63	
Consumption of meat products			0.09
Yes	7.91	6.78	
No	31.07	54.24	
Woreda			0.21
Banjia	10.73	17.51	
Jawi	8.47	19.77	
Dangila	19.77	23.73	

[a]: Chi square test.

Econometric analysis results: Results of the binary logistic regression model estimation reflected in terms of the odds ratio associated with each variable and their significance are shown in **Table 2**. Among the 11 categorical and continuous explanatory variables, healthy eating habit and consumption of fruits and vegetables had a significant (P<0.001) effect on the nutrition status of school-age children in the study area. The odds ratio values of these variables indicated that children who had a healthy eating habit were 343.4 times more likely to be nutritionally secured compared with those who did not; and children who consumed fruits and vegetables were 194 times more likely to enjoy nutrition security than those who do not consume fruits and vegetables. The odds ratio for milk consumption was significant (P=0.01), and those who did not consume milk were less likely to be nutritionally secured. Moreover, the odds ratio for Dangila was significant (P=0.03), which suggested that school-age children living in Dangila were 17.94 times more likely to have nutrition security compared to those living in Jawi. The odds ratio of educational status of the guardians was marginally significant (P=0.06), which suggested that school-age children with illiterate guardians were less likely to be nutritionally secured compared to the children with literate guardians. The odds ratios of all the other variables were not significantly different from 1.

The frequency of consuming different food products is shown in **Table 3**. While grain was consumed every day, fruits were not eaten by the respondents at all. Milk was not consumed in Jawi and Banjia woredas, but in Dangila woreda, the children had milk twice a week. Among the three woredas, school-age children in Banjia ate vegetables every day (7 days a week), but in Jawi and Dangila woredas, on average, they consumed them for only 1.5 and 3 days per week, respectively. The consumption pattern of oil products and iodine at the three woredas are compared in **Table 3**.

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Table 2. Binary Logistic regression model of nutrition security status regarding school-age children.

Variables	Odds ratio	*p*-value
Sex of the respondent (1 for male, 0 otherwise)	0.72	0.61
Age of the respondent	1.03	0.84
Educational status of the guardian (1 for illiterate, 0 otherwise)	0.28	0.06
Consumption of milk (1 for no, 0 otherwise)	0.20	0.01
Healthy eating habit (1 for yes, 0 otherwise)	343.40	<0.001
Consumption of fruits and vegetables (1 for yes, 0 otherwise)	194.00	<0.001
Consumption of meat products (1 for yes, 0 otherwise)	2.28	0.44
Consumption of iodine (1 for no, 0 otherwise)	2.12	0.33
Location dummy1 (benchmark = Jawi; 1 for Banja, 0 otherwise)	0.60	0.58
Location dummy2 (benchmark = Jawi; 1 for Dangila, 0 otherwise)	17.94	0.03
Weight	1.02	0.74
Height	1.01	0.70
Body mass index	0.83	0.18
Baseline odds	0.02	0.42

Table 3. Mean consumption frequency (days per week) by school-age children calculated using Helen Killer Food Frequency Method.

Location	Meat products	Grain	Fruits	Milk	Vegetables	Oil products	Iodine
Jawi	1	7	0	0	1.5	1.5	2
Banjia	1	7	0	0	7	2	2
Dangila	1.5	7	0	2	3	3	3
Zonal average	1.2	7	0	0.9	4.3	2.3	2.4

Discussion

Children at school-age (6–14) are in a vital period regarding overall growth and development. Stunting and wasting are the true indicators of undernutrition, particularly for younger children. Ethiopian children are at risk of inadequate quality protein intake, particularly after breastfeeding has ceased. (Gunaratna *et al.*, 2019). This study revealed that 44.6% of the school-age children in the study area were stunted, which was higher than the 38% nationwide percentage of the stunted children under five (Central Statistical Agency (CSA), 2017), and 37.9% percent of the stunted school-age children in Mecha District of the Amhara Region (Lisanu Mazengia and Andargie Biks, 2018). However, the percentage of stunted school-age children in the study area was similar to what was reported by (Getaneh *et al.*, 2019) for Gondar of Amhara Region (46.1%). Although Ethiopia was making a significant progress towards reducing stunting from 58% in 2000 to 38% in 2016 (Central Statistical Agency (CSA), 2017), there was disparity in the reduction rate at different parts of the country.

As summarized by (Iannotti, 2018), milk was among nature's first foods, which can provide holistic packages of nutrients and bioactive compounds that promote healthy growth. The results of the current study showed that milk consumption and nutrition security were significantly related, and the odds of school-age children who consumed milk was significantly higher than those who did not. In 2017, although Ethiopia had the largest number of cattle (61 million) in Africa, it had one of the lowest (30.86 kg per year) per capita milk consumption in Africa (Ritchie and Roser, 2017). This gap highlighted the need for more safe milk production and consumption in Ethiopia.

The findings of the current study indicated the

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importance of healthy eating habit for school-age children for nutrition security. To instill healthy eating habit in school-age children, providing nutrition education to the children and their guardians as early as possible is of great importance (Uzşen and Başbakkal, 2019). This education should include the nutrients and micronutrients of fruits and vegetables, which belong to the food products with a highly significant effect on nutrition security of school-age children. The consumption of fruits and vegetables in Ethiopia is very low. For example, Ruel *et al.* reported that the consumption of fruits and vegetables in Ethiopia was 26.7 kg/person/year (equivalent to 73.2 g/person/day) (Ruel *et al.*, 2005), which was way less than the ≥ 400 g/day recommended by World Health Organization (2003).

The relationship between the educational status of the guardian and nutrition security of the school-age child was marginally significant, and the odds ratio of literate guardians with nutritionally secured school-age children was marginally higher. These results were in agreement with the results of Taye *et al.* (2016) in the western part of Ethiopia.

The findings of this study also revealed that the association between meat consumption and nutrition security of school-age children was marginally significant; the more the children consumed meat, the more they benefited from nutrition security. Meat consumption in Ethiopia was low compared to other Sub-Sahara African countries. For instance, Desiere *et al.* reported that among the 7 Sub-Saharan African countries (Ethiopia, Malawi, Mali, Niger, Nigeria, Tanzania, and Uganda) studied, the lowest percentage (19%) of households consuming meat belonged to Ethiopia (Desiere *et al.*, 2018). This very small percentage value is partly because majority of Ethiopians are Orthodox Christians where they abstain from consuming animal products including milk and meat during the fasting period (Seleshe *et al.*, 2014).

The woreda where the children were located was also another factor that affected their nutrition security. Among the three woredas, the children in Dangila were more nutritionally secured than those in Jawi, whereas there was no significant difference between the odds ratio of the subjects' being located in Jawi or Banjia. This difference was directly linked to the differences in the availability/accessibility of healthy food products at different locations. Such differences had also been reported in other studies (Deng and Kahn, 2009, Tasic *et al.*, 2020).

Conclusions

This study revealed that 55.4% of the school-age children in the study area are underweight and nutritionally insecure, and 44.6% of them are stunted. The main reasons are lack of milk, meat, fruits, and vegetables consumption; unhealthy eating habit; having illiterate guardian; and the child's place of residence. The low consumption of milk, meat, fruits, and vegetables by school-age children shows that their dietary diversity is below the standard for healthy growth and development. Implementing nutrition education to the children and their guardians is recommended. There is also a need for introducing school feeding programs and revising the curriculum of schools to incorporate nutrition concerns in every grade, and more attention needs to be dedicated to the promotion of a healthy lifestyle based on a balanced and diversified dietary.

Conflict of interests

All the authors declared no conflict of interests.

Authors' contributions

Teshome F and Andaregie A designed the research study. Teshome F, Andaregie A and Assefa B performed the research. Teshome F, Andaregie A and Astatkie T analyzed the data. Teshome F, Andaregie A and Assefa B prepared the draft manuscript. Astatkie T critically reviewed and revised the manuscript. All authors have read and approved the final manuscript.

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