Determinants of Rural Women's Nutrition Security Status in Northwest Ethiopia

Fentaw Teshome (fentawta@gmail.com)
Injibara University

Adino Andaregie
Injibara University

Tessema Astatkie
Dalhousie University

Research Article

Keywords: Nutrition security, Determinants, Logit regression, SDGs

Posted Date: January 12th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-523385/v1

Determinants of Rural Women's Nutrition Security Status in Northwest Ethiopia

Fentaw Teshome[1*], Adino Andaregie[2] and Tessema Astatkie[3]

[1]Department of Agricultural Economics, Injibara University, Injibara, Ethiopia

[2]Department of Economics, Injibara University, Injibara, Ethiopia

[3]Faculty of Agriculture, Dalhousie University, Truro, Canada

*** Correspondence:** fentawta@gmail.com

Abstract

Background: Nutrition security of women is one of the most vital foundations for overall development and wellbeing of society. Since understanding the factors that influence the nutrition security of women is very important for implementing appropriate interventions, this study was conducted to determine the determinants of the nutrition security status of rural women in Northwest Ethiopia.

Methods: Survey data were collected from 197 rural women randomly selected using a two-stage sampling method (Cluster sampling in the first stage and Stratified random sampling in the second stage). Data in the two outcomes (nutritionally secured whose BMI $\geq$ 18.5, and nutritionally insecure whose BMI < 18.5 kg/m^2) were analyzed using Binary Logit regression model to determine the significance of the determinants on women's nutrition security status.

Results: The study showed that 72.6% of the women in the study area were nutritionally insecure. Results of the statistical analysis revealed that family size (negative effect), and women's daily feed frequency, the consumption of milk, fruits and vegetables, and animal products, and women empowerment (all positive effect) were the significant determinants of the nutrition security status of rural women. The weight, the height, and the BMI of nutritionally insecure women (44 kg, 1.45 m, and 15.8 kg/m^2, respectively) were significantly lower than those of nutritionally secured women (50.8 kg, 1.55 m, and 21.1 kg/m^2, respectively).

Conclusions: This is the first study on the determinants of rural women's nutrition security status using social and demographic data collected at the grass root level and analyzed using an advanced econometric model. The findings of the study show the need for government and other stakeholders' interventions to increase access to nutritious food products and to provide trainings on feeding culture and dietary diversity to women. The findings of this study can help the Government of Ethiopia to achieve its National Development Priorities in line with the Sustainable Development Goals (SDGs) of UN, particularly Goals 2, 3 and 5.

Keywords Nutrition security, Determinants, Logit regression, SDGs

Background

The 2030 Agenda for Sustainable Development adopted by United Nations in 2015 has a vision of overcoming hunger, food insecurity, and malnutrition [1]. Hunger is rising in almost all sub-

regions of Africa and, to a lesser extent, in Latin America and Western Asia [2]. Lack of reliable access to nutritious food puts people in these regions at a higher risk of malnutrition and poor health [1].

Good nutrition is central to the 2030 Agenda, which supports the achievement of several of the Sustainable Development Goals (SDGs) of the United Nations including ending poverty (SDG 1), zero hunger (SDG 2), good health and well-being (SDG 3), ensuring quality education (SDG 4), promoting gender equality (SDG 5), and reducing inequalities (SDG 10) [3]. Most of these SDGs are interconnected. For example, SDG 1 and SDG 2 are interconnected with 10 and 8 other SDGs, respectively [4]. Malnutrition, in all its forms, is caused by a complex set of interacting factors, including inadequate, unbalanced, or excessive consumption of macronutrients that provide dietary energy (carbohydrates, protein and fats) and micronutrients [5].

As part of sub-Saharan Africa, Ethiopia is facing poverty, and food and nutrition insecurity. Wondifraw et al. [6] reported that around 23 million Ethiopians live under the basic poverty line, and food insecurity continues to be a challenge. Furthermore, in Ethiopia, around 44% of children under five are malnourished and stunted mainly due to drought and the spread of diseases [7]. Moreover, it was reported that food insecurity and poverty incidence were higher in rural areas [8]. In Ethiopia, some 70% of the women fall under the "normal" body mass index (BMI, calculated as BMI = weight(kg)/height(m)^2) category, which is between 18.5 and 25 BMI, while 22.3% are underweight (<18.5 BMI) because of inadequate energy intake and/or disease [9]. These BMI cutoffs are based on WHO classification [10].

According to [9], Amhara Region experienced the highest percentage of food insecure households (36.1%), followed by Afar (26.1%) and Tigray (24.7%) regions of Ethiopia. Overall, rural households are more food insecure than urban households according to all indicators except calorie deficiency. Rural areas experience higher rates of stunting (39.9%) as compared with urban areas (25.4%). Regionally, the highest prevalence is found in rural households of Amhara region (46.3%), followed by Benishangul Gumuz (42.7%) and Afar (41.1%) [9].

Various studies have been conducted on the determinants of nutrition security status of rural households in different countries. For example, a study conducted on the determinants of nutrition security in rural households in Myanmar found out that having a large family size

increases the probability of being nutritionally insecure [11]. Lentz [12] reported that women, considering the realities and possibilities of domestic violence, weigh choices on food consumption and distribution, and often choose to eat less of lower quality foods in rural Bangladesh. It was also reported that farm production diversification continues to be strongly associated with increasing household's dietary diversity and is highly associated with nutrition security of households in Ghana [13]. Several studies were conducted in different countries to study the demographic, socio-economic, institutional, and geographical determinants of nutrition security status of households by employing different methods of analysis [12, 14-27].

Amfo et al. [28] reported that, in Ghana, protein-rich foods take a smaller proportion of the household's food budget, whereas vegetables and cereals take more than half of the household's food budget. Poor households spend a larger proportion of their income on food compared with that of wealthier households, although absolute amounts spent on food takes the opposite direction. Furthermore, food safety consciousness and income groupings significantly influence the expenditure of households on vegetables at different quantiles. Expenditure of food safety conscious and high-income consumers are positioned on higher quantiles.

Drought shocks lead household diets to become less balanced because the shocks force households to rely primarily on cereals, and to purchase less vegetables, fruits, pulses, and animal-sourced foods in rural India, leading rural households to be nutritionally insecure [17]. A study by Pritchard et al. [18] in rural Myanmar showed that landholding households are more likely to be food and nutritionally secured because land holding helps households to produce diverse products, which in turn helps to have higher dietary diversity. Consuming fresh fruits and vegetables was reported to have a significant contribution to nutrition security [19].

In Vietnam, pork is the main livestock product consumed, and daily meals prepared by women are responsible for the nutrition security in the country [20]. Livestock and animal source foods play a crucial role in reducing poverty, and improving nutrition security, livelihoods, gender equity, and health [21]. Bundala et al. [22] suggested that promoting livestock keeping at homestead level and changes in nutrition behavior strategies focusing on the importance of consuming animal source foods are crucial for attaining adequate consumption of nutritious foods.

Family size (adult equivalent) was reported to have a highly significantly negative effect on food security status in Afar Region of Ethiopia [27]. Kousar et al. [29] reported that the number of employed household members, level of income, and education are positively associated with household spending on education and nutrition by male- and female-headed households; and Cherotich et al. [30] reported a positive association between women's financial knowledge and the amount of savings and profit margins from their farm enterprises. This study was carried out to determine the factors (determinants) influencing the nutrition security status of rural women in Northwest Ethiopia by using a household survey data conducted in 2019 and analyzed using a binary Logit regression model.

Methods

Conceptual framework of determinants

The conceptual framework of the determinants of nutrition security status of women was designed as shown in Fig. 1. Consumption of milk, vegetables, fruits, and animal products are expected to be important determinants of nutrition security status of women because these are important nutritious foods. The agronomic conditions of the study area have a good potential for accessing vegetables, cereals, and dairy products that could help rural households to be nutritionally secured and would make the women to have normal weight and height. However, there are other factors such as demographic, socio-economic, physical, and food consumption habit that can influence the nutrition security status of women.

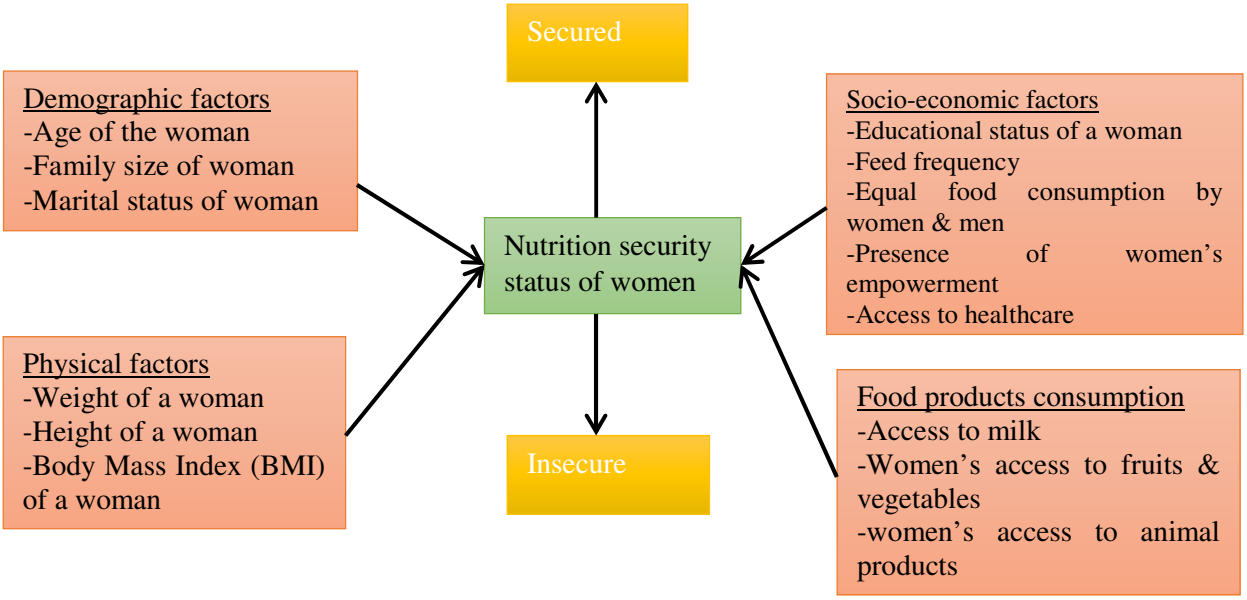

Fig. 1 Conceptual framework of the study

Sampling and data collection

The target population of the study was all rural women households in Awi administrative zone, Northwest Ethiopia. Awi zone has a total area of 9148 square km; topographically, it is relatively flat and fertile, and its elevation ranges from 1800 to 3100 m a.s.l. The Zone has 10 districts (equivalent to counties) with a total of 1,681 rural households. A two-stage sampling method was used where cluster sampling was used in the first stage to select 3 districts randomly among the 10 districts. Cluster sampling was used in the first stage because the districts within the zone can be considered as similar in terms of factors affecting nutrition security status. However, within each district, the households can be stratified by their geographical locations that differ in terms of their access to nutritious food and stratified random sampling was used in the second stage. In the selected three districts, there are 388 rural households. A sample size of n = 197 was determined according to Yamane [31] sample size determination formula at 5% level of precision using the following formula:

$n = \frac{N}{1+N(e^2)}$, where N is the population size in the three districts (388) and e is the level of precision. The sample size was proportionally allocated to the strata and data were collected from the randomly selected rural households using structured questionnaires in a face-to-face interview.

Method of data analysis

The method of data analysis to meet the research objectives was binary Logit regression model. The Logit model is flexible and can be used easily. Furthermore, this model allows meaningful interpretations of the results when the dependent variable has dichotomous (binary) outcome [32]. The binary outcomes in this study are nutritionally secured (when the BMI of the woman is ≥ 18.5) and nutritionally unsecured (when the BMI is < 18.5). These binary outcomes were used based on WHO's classification [10]. The logit regression model is a powerful tool in its ability to estimate the individual effects of the continuous or categorical variables on qualitative dichotomous dependent variables [33]. Following Gujarati [32], the Logit distribution function

for the relationship between the probability of the dependent dichotomous variable and various independent variables is specified as:

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

For simplicity, this can be re-written as:

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

where P_i is the probability that a woman is nutritionally secured; and its value ranges from 0 to 1 and it is non-linearly related to Z_i (i.e., the explanatory variables x_i's). e^{Z_i} is standard for irrational number e to the power of Z.

Z_i is a function of k explanatory variables (x_i), which is also expressed as:

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

where x_1, x_2, …., x_k are the k explanatory variables; β_0 is the intercept; β_1, β_2, …. β_k are the Logit parameters (coefficients) of the determinates (factors) of nutrition security status of women in the model. Since P_i is the probability of the nutrition security status of a woman being secured, $(1 - P_i)$ is the probability of the nutrition status of a woman being not nutrition secured, which can be written as:

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

Thus, the expression $P_i/(1 - P_i)$ is known as the odds ratio and can be expressed 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 Logarithm of equation (5), we can get

$$\ln(P_i/1 - P_i) = Z_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki} \quad (6)$$

where L_i is log of the odds ratio, which is not only linear in x_i but also linear in the parameters.

Finally, by introducing the error term u_i we get the following theoretical Logit model:

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

In this study, based on previous studies, demographic, socio-economic, physical level, and consumption of food products factors that are expected to have effect on the nutrition security status of women in Northwest Ethiopia were considered as explanatory variables. To ensure that

there is no multicollinearity among the explanatory variables, Tolerance ($1-R^2$), and Variance Inflation Factor (VIF) calculated as the reciprocal of Tolerance were obtained using "collin" command in STATA. The R^2 used to calculate Tolerance for the jth explanatory variable is obtained from regressing it against all other explanatory variables. The rule of thumb is that a VIF > 10 (or Tolerance < 0.1) provides evidence of collinearity. Since all our VIF values were below 4.23 and the average VIF was 1.66, there was no multicollinearity problem in our model.

The explanatory variables used in the binary Logit model are:

x_1 = Age of the woman measured in years

x_2 = Family size (adult equivalent) of woman measured by the number of people in the family

x_3 = Feed frequency measured by the number of times a woman consumes food per day

x_4 = Weight of a woman measured in kg

x_5 = Height of a woman measured in m

x_6 = Body mass index (BMI) of a woman measured in kg/m^2

x_7 = Marital status of a woman (dummy variable: 1 = married and 0 = otherwise)

x_8 = Educational status of a woman (dummy variable: 1 = literate; 0= otherwise)

x_9 = Access to milk products (dummy variable: 1 = Yes; 0 = otherwise)

x_{10} = Equal food consumption by women and men (dummy variable: 1 = Yes; 0 = otherwise)

x_{11} = Woman's access to fruits and vegetables? (dummy variable: 1 = Yes; 0 = otherwise)

x_{12} = woman's access to animal products (dummy variable: 1 = Yes; 0 = otherwise)

x_{13} = Participation in economic activities by woman as a proxy for the presence of woman's empowerment (dummy variable: 1 = Yes; 0 = otherwise)

x_{14} = Is there access to healthcare facilities for woman? (dummy variable: 1 = Yes; 0 = otherwise)

Results

Descriptive characteristics of respondents

Comparison results of the nutritionally secured and unsecured women in terms of the mean values of the continuous variables are shown in Table 1. Accordingly, the mean ages of secured and unsecured women were 34 and 36 years, respectively; and these means were not significantly different. On the other hand, family size of women was an important variable that determines the nutrition security status of women. The average family size of nutritionally secured and unsecured women were 3 and 5 people, respectively (Table 1), and these means were highly significantly different ($p < 0.001$). This result suggests that having a smaller family size is related to being more nutritionally secured. The other variable with highly significantly different means was feed frequency where nutritionally secured women ate three times a day whereas nutritionally unsecured women ate only two times (Table 1).

The average weight of nutritionally secured women was 50.8 kg while that of unsecured women was 44 kg, and the difference was significant at the 1% level. There was also a highly significant difference between the mean height of the nutritionally secured (1.55 m) and unsecured (1.45 m) women (Table 1). The difference between the mean BMI of nutritionally secured (21.1 kg/m^2) and unsecured (15.8 kg/m^2) women was also highly significant. The mean BMI value of nutritionally secured women is closer to the center (21.7 kg/m^2) of the range for healthy (normal BMI) women (18.5–24.9 kg/m^2).

Table 1 Comparison of the nutritionally secured and unsecured women in terms of the mean values of the continuous variables

Variable	Security status		P-value[a]
	Secured (n_1 = 54)	Unsecured (n_2=143)	
Age of the woman (years)	34[10.75]	36[10.90]	0.132
Family size of woman in number of people	3[1.85]	5[1.28]	<0.001***
Feed frequency of woman per day	3[0.79]	2[0.62]	<0.001***
Weight of a woman (kg)	50.8[6.89]	44[8.59]	<0.001***
Height of a woman (m)	1.55[0.06]	1.45[0.09]	<0.001***
BMI (body mass index of a woman in kg/m^2)	21.1[3.04]	15.8[3.24]	<0.001***

[a]***, **, and * represent significant difference at the 1%, 5%, and 10% level of significance, respectively. The values shown in parenthesis are standard deviations.

Results of the χ^2 tests of independence between nutrition status of women (2 categories: secured and unsecured) and 8 categorical variables are shown in Table 2. Accordingly, there was no significant relationship between nutrition status and marital status (p = 0.359). Milk consumption of women was another categorial variable that was highly significantly related to nutrition security status (p < 0.001) where disproportionally higher percentage of nutritionally secured women have access to milk for consumption. Specifically, 41% of the respondents have access to milk and 59% of them did not. Among the women who consumed milk, 65% and 35% were nutritionally secured and unsecured, respectively (Table 2). Among the women who did not have access to milk, only 2% were nutritionally secured, and 98% were not.

Table 2 χ^2 test of independence to test if there is a relationship (H_a) between nutrition Security status of women and 8 categorical dummy variables

Dummy Variable	Category	Security status		P-value[a]
		Secured (54)	Unsecured (143)	
Marital status of woman	Single	7	8	0.359
	Married	43	54	
	Divorced	4	7	
	Widowed	0	4	
Educational status of woman	Literate	36	51	<0.001***
	Illiterate	18	92	
Does the woman have access to milk?	Yes	52	28	<0.001***
	No	2	115	
Is there equal consumption of food by men and women?	Yes	24	71	0.514
	No	30	72	
Does the woman have access to fruits and vegetables?	Yes	46	18	<0.001***
	No	8	125	
Does the woman have access to animal products?	Yes	23	41	0.063*
	No	31	102	
Does the woman have empowerment?	Yes	38	40	<0.001***
	No	16	103	
Does the woman have access to healthcare facilities?	Yes	23	25	<0.001***
	No	31	118	

[a]***, **, and * represent significant relationship at 1%, 5%, and 10% level of significance, respectively.

Respondents were asked whether there is equality of food consumption between women and men in their household. The results suggested that there was no relationship between this categorial variable and nutrition status of women (p = 0.514). However, women's access to and habit of consuming fruits and vegetables was highly significantly related with nutrition security status of women (Table 2). Among the nutritionally secured women, 85% of them have the consumed fruits and vegetables, but among the nutritionally unsecured women, this percentage is only 13%. On the other hand, the relationship between women's access to animal products and nutrition security status was only marginally significant (p = 0.063). Among the nutritionally secure women, 43% consume animal products but among the nutritionally unsecure women, a smaller proportion (29%) of them consumed animal products.

The respondents were also asked whether they participated in different economic activities as a proxy for the presence of woman's empowerment. This categorical variable was highly significantly related with nutrition security status (Table 2). The results revealed that a high percentage (70%) of the nutritionally secure women participated, and a small percentage (28%) of the nutritionally unsecure women participated as a proxy for the presence of woman's empowerment. Access to healthcare facilities was another categorical variable highly related with nutrition security status. Disproportionally larger percentage (43%) of nutritionally secure women had access to healthcare facilities compared to that of nutritionally unsecure women (17%). This disparity could be because women who have access to healthcare facilities may get advice on the nutrition system and nutritious food products that can help them to be nutritionally secured.

Determinants of women's nutrition security

The results shown in Table 3 indicate that among the 14 explanatory variables included in the model, one variable (Access to milk) was highly significant (p = 0.004), 3 variables (Family size, Feed frequency, and Presence of woman's empowerment) were significant (p = 0.023, 0.024, 0.049, respectively), and 3 variables (women's Weight, Access to Fruits and vegetables,

and Access to Animal products) were marginally significant (p = 0.075, 0.064, and 0.092, respectively) determinants of nutrition security of women.

As expected, access to milk was highly significantly and positively related with nutrition security status of women (Table 3). This result reveals that women who have access to milk were more likely to be nutritionally secured than those who did not have access to milk products. The coefficient of Family size is negative implying that having a large family makes it harder for women to provide nutritionally rich food to family members.

The availability of food and the frequency of feeding in each day or the number of dishes per day is an important variable influencing the nutrition security of women. The Logit model regression results showed a significantly positive coefficient of feeding frequency and the presence of woman's empowerment. Although it is marginally significant, weight, and access to fruits and vegetables, and animal products have positive effect on the nutrition status of women.

Table 3 Determinants of women's nutrition security based on Logit regression model

Variable	Coefficient	P-value[a]
Intercept	-29.86	0.038**
Age of the woman (years)	-0.067	0.323
Family size of woman in the number of people in the family	-1.364	0.023**
Feed frequency in the number of times a woman consumes food/day	4.503	0.024**
Weight of a woman (kg)	0.201	0.075*
Height of a woman (m)	0.276	0.709
Body mass index (BMI) of a woman (kg/m^2)	0.084	0.801
Marital status of a woman (1 = married and 0 = otherwise)	1.374	0.290
Educational status of a woman (1 = literate; 0= otherwise)	0.264	0.868
Access to milk (1 = Yes; 0 = No)	11.03	0.004***
Equal food consumption by women and men (1 = Yes; 0 = No)	-1.738	0.435
Woman's access to fruits and vegetables (1 = Yes; 0 = No)	2.844	0.064*
Woman's access to animal products (1= Yes; 0 = No)	3.443	0.092*
Presence of woman's empowerment (1 = Yes; 0 = No)	3.187	0.049**

Is there access to healthcare facilities for woman? (1 = Yes; 0 = No)	2.084	0.238

[a]***, **, and * represents significant determinant at 1%, 5%, and 10% level of significance, respectively.

The marginal effects of socio-economic variables on nutrition status of women

The marginal effects (ME) of the determinants of nutrition security status of women are shown in Table 4. The marginal effect of Milk consumption was significant (p = 0.035), and the marginal effect of 5 variables (Family size, Feed frequency, access to Fruits and vegetables, access to Animal products, and Presence of woman's empowerment) were marginally significant (p = 0.051, 0.076, 0.081, 0.092, and 0.052, respectively). The results show that for women who consumed milk, their chance of being nutritionally secured increases by 51% (Table 4). This suggests that access to milk products has an important role in improving nutrition security of women.

Table 4 The marginal effects of the determinants (variables) on women's nutrition security status

Variable	Coefficient	P-value[a]
Age of the woman (years)	-0.001	0.323
Family size of woman in the number of people in the family	-0.001	0.051*
Feed frequency in the number of times a woman consumes food/day	0.011	0.076*
Weight of a woman (kg)	-0.001	0.654
Height of a woman (m)	0.058	0.709
Body mass index (BMI) of a woman (kg/m^2)	0.001	0.801
Marital status of a woman (1 = married and 0 = otherwise)	0.003	0.290
Educational status of a woman (1 = literate; 0= otherwise)	0.016	0.868
Access to milk (1 = Yes; 0 = No)	0.510	0.035**
Equal food consumption by women and men (1 = Yes; 0 = No)	-0.001	0.435
Woman's access to fruits and vegetables (1 = Yes; 0 = No)	0.023	0.081*

Woman's access to animal products (1= Yes; 0 = No)	0.022	0.092*
Presence of woman's empowerment (1 = Yes; 0 = No)	0.010	0.052*
Is there access to healthcare facilities for woman? (1 = Yes; 0 = No)	0.015	0.238

[a]***, **, and * represents significant determinant at 1%, 5%, and 10% level of significance, respectively.

An increase in the family size of a woman by 1 person decreases the likelihood of the woman being nutritionally secured by 0.1% (Table 4). On the other hand, an additional increase in feeding frequency by one time increases the chance of being nutritionally secured by 1.1%. Having consumption habit of fruits and vegetables, and animal products increase the likelihood of being nutritionally secured by 2.3% and 2.2%, respectively. Being an economically empowered woman increases the probability of being nutritionally secured by 1%, which is consistent with what was reported by [27].

Discussion

The lower weight of the nutritionally unsecured women could be a reflection of their current nutrition status; however, their lower height indicates that they were also nutritionally unsecured since childhood. This result is also in agreement with that of Hackett et al. [34] who reported that the risk for a child to be stunted (their height is below the WHO standard for their age) and underweight increases as household food insecurity became more severe.

The highly significant relationship between nutrition status and educational level indicated that disproportionally higher percentage of unsecured women are illiterate. These results indicate that being literate has a positive contribution on women's nutrition security status. This finding is consistent with a report from Pakistan [29].

The benefit of consuming milk is not only increasing the chance of being nutritionally secure, but also decreasing the chance of being stunt, particularly for girls [15]. The negative coefficient of Family size observed in this study implies that having a large family makes it harder for women to provide nutritionally rich food to family members. This result is consistent with that of Kahsay et al. [27] who reported a highly significantly negative effect of family size

on food security status in the Afar Region of Ethiopia. This is true in other parts of the world as well. For example, in rural Myanmar, an increase in family size increased the chance of the household needing to change their diet to cheaper and less nutritious food products [11]. A significant association between the number of household members and women's dietary diversity was also reported in Ghana [35].

Feeding frequency and the presence of woman's empowerment are important determinants of nutrition security of women as they reflect availability of healthy food and empowerment of women to be active players in the socioeconomic and social development of the country, which is positively related to nutrition security. This is consistent with what was reported by Pallegedara [36] where per capital income, educational level of the head of the households, food prices, rural-urban affiliation, and ethnic background significantly affect the consumption decision of major food items.

The positive effect of access to fruits and vegetables on nutrition security reflects two things; availability of fruits and vegetables and women's awareness of the nutritional benefits of fruits and vegetables. When fruits and vegetables are not available due to droughts, households tend to rely less on fruits and vegetables, which causes rural households to be nutritionally unsecure [17]. On the other hand, in rural Myanmar, landholding households are more likely to be food and nutritionally secured because land holding helps households to produce diverse products including fruits and vegetables [18]. The positive effect found in this study is also consistent with that of McMullin et al. [19] who reported that consuming fresh fruits and vegetables has a significant contribution to nutrition security. Lifestyle interventions also has a significant effect on improving vegetables intake by pregnant women [37]. The positive effect of consumption of animal products is consistent with what was reported previously where consumption of pork by women as their main livestock product improved the nutrition security of women in Vietnam [20].

Our study has some limitations. This study covered only the nutrition security status of women in Northwest Ethiopia, which is a small area of the country, and the findings may not be applicable in all parts of Ethiopia. Therefore, nutrition security status of women living in other rural areas of Ethiopia need to be studied. Although this study attempted to identify the determinants of nutrition security status of women, there can be other factors that influence

nutrition security status and need to be studied. These other factors could be the households' income, farm size, livestock holding size, productivity of their land, and marketability of their produces.

Conclusions

Results of the Binary Logit regression model showed that family size (adult equivalent) of a woman, feeding frequency (food consumption per day), access to milk , access to fruits and vegetables, and consumption of animal products have significant effect on nutrition security status of rural women in Northwest Ethiopia. There was no significant difference between the consumption of food by men and women.

The findings of the study indicate that there is a need for a holistic approach for improving the nutrition security status of rural women. Adequate nutrition requires a multi sectorial effort that, in turn, requires individual, institutional system-level collaborators to implement effective interventions through engagement across different sectors and stakeholders. Effective implementation requires coherence within sectors and stakeholder institutions to ensure that no one is left behind, particularly the poor and the vulnerable groups. This study provides useful information on the determinants of nutrition security of women that can help the government of Ethiopia and other development actors to turn the life of the rural population of Ethiopia, especially women and children from zones of economic misery to zones of economic prosperity. The significantly lower weight and height of nutritionally insecure women show the need for dietary diversity and government and other stakeholders' interventions to increase access to nutritious food products and to provide trainings on the dietary needs of rural women in Northwest Ethiopia.

Abbreviations

FAO	Food and Agricultural Organization
SDGs	Sustainable Development Goals
UNDP	United Nations Development Program

WFP	World Food Program
CSA	Central Statistical Agency
BMI	Body Mass Index
ME	Marginal Effects

Declarations

Ethics approval and consent to participate

This study was approved by Injibara University Research and Community Service Directorate (3584/18) that oversees research grant and research ethics for studies conducted by the researchers of Injibara University. The research ethics followed the National Research Ethics Guidelines released by Ministry of Science and Technology of the Federal Democratic Republic of Ethiopia in 2014. Written informed consent was obtained from all participants prior to the interview.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

All authors declare that they have no competing interests.

Funding

This study was financially supported by Injibara University to cover associated costs required for data collection. The funding body had no role in the design of the study, data collection, analysis, interpretation of the results, and the writing of the manuscript.

Author's contributions

FT and AA analyzed and interpreted the data collected from rural women. TA improved the statistical part of the study and was a major contributor in the writing and preparation of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We would like to acknowledge health and agricultural extensions agents working in Northwest Ethiopia for their help during data collection.

References

1. FAO. The state of food security and nutrition in the world: Safeguarding against economic slowdowns and downturns. Rome, Italy: Food and Agricultural Organization (FAO); 2019.
2. FAO. Africa Regional Overview of Food Security and Nutrition: Containing the Damage of Economic Slowdowns and Downturns to Food Insecurity in Africa. Rome, Italy: Food and Agricultural Organizations (FAO); 2019.
3. Hawkes C, Fanzo J. Global nutrition report 2017: Nourishing the SDGs. Bristol, UK: Development Initiatives Poverty Research Ltd; 2017.
4. Le Blanc D. Towards integration at last? The sustainable development goals as a network of targets. Sust Dev. 2015;23(3):176-87.
5. UNSCN. Sixth report on the world nutrition situation 2010. Geneva, Switzerland: United Nations Standing Committee on Nutrition (UNSCN); 2010.
6. Wondifraw Z, James W, Haile K. UNDP 2016: African Economic Outlook. http://www.africaneconomicoutlook.org/ Accessed 16 July 2020.
7. UNDP. Country Program Document for Ethiopia (2016-2020) 2016: First Regular Session. New York: United Nations Development Program (UNDP); 2016. http://www.et.undp.org/ Accessed 5 July 2020.
8. FAO. The State of Food Security and Nutrition in the World. Rome, Italy: Food and Agricultural Organization (FAO); 2017.
9. WFP and CSA. Comprehensive food security and vulnerability analysis (CFSVA). Addis Ababa, Ethiopia: World Food Program (WFP) Ethiopia Office and Central Statistical Agency (CSA); 2019.
10. WHO. Report of a WHO Consultation on Obesity. Obesity: preventing and managing the global epidemic. Geneva, Switzerland: World Health Organization (WHO); 1998.

11. Rammohan A, Pritchard B. The role of landholding as a determinant of food and nutrition insecurity in rural Myanmar. World Dev. 2014;64:597-608.
12. Lentz EC. Complicating narratives of women's food and nutrition insecurity: Domestic violence in rural Bangladesh. World Dev. 2018;104:271-80.
13. Ecker O. Agricultural Transformation and food and nutrition security in Ghana: Does farm Production diversity (still) matter for household dietary diversity? Food Policy. 2018;79:271-82.
14. Bentley GR, Aunger R, Harrigan AM, Jenike M, Bailey RC, Ellisen PT. Women's strategies to alleviate nutritional stress in a rural African society. Soc Sci Med. 1999;48:149-62.
15. Pei XP, Ti YT, Juan X, Li, L, Wei C, Qian G, Qi HX, Hui P, et al. Dairy consumption and associations with nutritional status of Chinese children and Adolescents. Biomed Environ Sci. 2019;32(6):393-405.
16. Nakakawa F, Mugisha J, Diiro GM, Kaaya AN, Tumwesigye NM. Food and nutrition status of households with women living with HIV in Uganda. Sci African. 2020;8:e00394. https://doi.org/10.1016/j.sciaf.2020.e00394.
17. Carpena F. How do droughts impact household food consumption and nutritional intake? A study of rural India. World Dev. 2019;122:349-69.
18. Pritchard B, Rammohan A, Vicol M. The importance of non-farm livelihoods for household food security and dietary diversity in rural Myanmar. J Rural Stud. 2019;67:89-100.
19. McMullin S, Stadlmayr B, Roothaert R, Jamnadass R. Fresh fruit and vegetables: contributions to food and nutrition security. In: Ferranti P, Berry EM, Anderson JR, editors. Encyclopedia of food security and sustainability, 3: Sustainable Food Systems and Agriculture. Amsterdam: Elsevier; 2019. p. 217–25.
20. Nguyen-Viet H, Dang-Xuan S, Pham-Duc P, Roesel K, Huong NM, Luu-Quoc T, Hung PV, Nga NTD et al. Rapid integrated assessment of food safety and nutrition related to pork consumption of regular consumers and mothers with young children in Vietnam. Glob Food Sec. 2019;20:37-44.
21. Adesogan AT, Havelaar AH, McKune SL, Eilittä M, Dahl GE. Animal source foods: Sustainability problem or malnutrition and sustainability solution? Perspective matters. Glob Food Sec. 2020;25;100325. https://doi.org/10.1016/j.gfs.2019.100325.

22. Bundala N, Kinabo J, Jumbe T, Rybak C, Sieber S. Does homestead livestock production and ownership contribute to consumption of animal source foods? A pre-intervention assessment of rural farming communities in Tanzania. Sci African. 2020;7. https://doi.org/10.1016/j.sciaf.2019.e00252.
23. Chrisendo D, Krishna VV, Siregar H, Qaim M. Land-use change, nutrition, and gender roles in Indonesian farm households. For Policy Econ. 2020;118:102245. https://doi.org/10.1016/j.forpol.2020.102245.
24. Galiè A, Teufel N, Girard AW, Baltenweck I, Dominguez-Salas P, Price MJ, Jones R, Lukuyu B, et al. Women's empowerment, food security and nutrition of Pastoral communities in Tanzania. Glob Food Sec. 2019;23:125-34.
25. Holland C, Rammohan A. Rural Women's empowerment and Children's food and nutrition security in Bangladesh. World Dev. 2019;124:104648. https://doi.org/10.1016/j.worlddev.2019.104648.
26. Hasselberg AE, Aakre I, Scholtens J, Overa R, Kolding J, Bank MS, Atter A, Kjellevold M. Fish for food and nutrition security in Ghana: Challenges and Opportunities. Glob Food Sec. 2020;26:100380. https://doi.org/10.1016/j.gfs.2020.100380.
27. Kahsay ST, Reda GK, Hailu AM. Food security status and its determinants in pastoral and agro-pastoral districts of Afar regional state, Ethiopia. African J Sci Technol Innov Dev. 2020;12(4):333-41. https://doi.org/10.1080/20421338.2019.1640429.
28. Amfo B., Ansah IGK, Donkoh SA. The effects of income and food safety perception on vegetable expenditure in the Tamale Metropolis, Ghana. J Agribusiness Dev Emerg Econ. 2019;9(3):276-93. https://doi.org/10.1108/JADEE-07-2018-0088.
29. Kousar K, Sadaf T, Makhdum MSA, Ijaz A. Determinants of household's education and nutrition spending: A gender based empirical analysis. Humanomics. 2017;33(4):470-83.
30. Cherotich J, Ayuya OI, Sibiko KW. Effect of Financial Knowledge on Performance of Women Farm Enterprises in Kenya. J Agribusiness Dev Emerg Econ. 2019;9(3):294-311. https://doi.org/10.1108/JADEE-06-2018-0083.
31. Yamane, T. 1967. Statistics: An introductory Analysis. 2nd ed. New York, NY: Harper and Row.
32. Gujarati D. Basic Econometrics. 3rd ed. New York: McGraw Hill; 1998.

33. Wright RE. Logistic regression. In: Grimm LG, Yamold PR, editors. Reading and understanding multivariate statistics. Washington, DC: American Psychological Association; 1995.
34. Hackett M, Melgar-Quiñonez H, Álvarez MC. Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia. Rev Panam Salud Publica. 2009;25(6):506–10.
35. Amugsi DA, Lartey A, Kimani-Murage E, Mberu BU. Women's participation in household decision-making and higher dietary diversity: findings from nationally representative data from Ghana. J Health Popul Nutr. 2016;35(1):16.
36. Pallegedara A. Food Consumption choice and demand by the Sri Lankan households: Trends, Drivers and policy Implications. J Agribusiness Dev Emerg Econ. 2019;9(5):520-35. https://doi.org/10.1108/JADEE-01-2019-0014
37. Aşcı Ö, Rathfisch G. Effect of lifestyle interventions of pregnant women on their dietary habits, lifestyle behaviors, and weight gain: a randomized controlled trial. J Health Popul Nutr. 2016;35(1):7.