Socio-demographic and economic factors are associated with nutritional status of adolescent school girls in Lay Guyint Woreda, Northwest Ethiopia

Getachew Arage[1], Mekonnen Assefa[2] and Teshager Worku[3]

Abstract

Objective: This study was aimed at assessing socio-demographic and economic factors associated with nutritional status of adolescent school girls in Lay Guyint Woreda, Northwest Ethiopia.

Methods: The school-based cross-sectional study comprising 362 adolescent girls aged 10–19 years was included in the study. Simple random sampling technique with proportional allocation to size was used to select the participants. An interviewer-administered questionnaire and anthropometric measurement were used to collect the data. An anthropometric measurement was converted to the indices of nutritional status using World Health Organization Anthro Plus software.

Result: The overall prevalence of stunting and thinness among adolescent girls were 16.3% and 29%, respectively. Adolescents aged 14–15 years (AOR = 3.65; 95% confidence interval: 1.87, 7.11), adolescents living in rural areas (AOR = 1.34; 95% confidence interval: 1.24, 2.33), and adolescents who did not have snack (AOR = 11.39; 95% confidence interval: 1.47, 17.8) were positively associated with stunting. Whereas mother's occupation was negatively associated with stunting (AOR = 0.12; 95% confidence interval: 0.17, 0.87). Similarly, being a rural resident (AOR = 2.40; 95% confidence interval: 1.13, 5.08) and adolescents aged 14–15 years (AOR = 6.05; 95% confidence interval: 2.15, 17.04) were positively associated with thinness. Educational status of adolescent girls was negatively associated with thinness (AOR = 0.13; 95% confidence interval: 0.05, 0.35).

Conclusion: Stunting and thinness are prevalent among adolescent girls. The age of adolescents, place of residence, having a snack, and mother's occupation was significantly associated with stunting and thinness. Having at least a one-time snack in addition to the usual diet is strongly recommended.

Introduction

The World Health Organization (WHO) defines adolescents as young people aged 10–19 years. Adolescence is a journey from the world of the child to the world of the adult.[1] Adolescence can be divided into three stages. Early adolescence (10–13 years) is characterized by a spurt of growth and the beginnings of sexual maturation. In mid-adolescence (14–15 years), the main physical changes are completed, while the individual develops a stronger sense of identity. In later adolescence (16–19 years), the body fills out and takes its adult form.[1] Adolescence is the only time following infancy when the rate of physical growth actually increases. For this to happen, there is a greater demand for calories and nutrients. Thus, it is a time of increased nutritional requirements.[2] Poor nutrition can have lasting consequences on an adolescent's cognitive development, resulting in decreased learning ability, poor concentration, and impaired school performance.[3,4]

[1]Department of Nursing, College of Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia
[2]Department of Public Health, College of Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia
[3]School of Nursing and Midwifery, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia

Corresponding author:
Teshager Worku, School of Nursing and Midwifery, College of Health and Medical Sciences, Haramaya University, P.O. Box-235, Harar 3220, Ethiopia.
Email: teshager.kassie@gmail.com

Malnutrition in adolescence encompasses undernutrition as well as overnutrition.[5] Undernutrition implies being underweight for one's age, too short for one's age (stunted), or deficient in vitamins and minerals.[6] Long-term undernutrition is an important cause of stunting or short height-for-age.[7] Many boys and girls in developing countries enter adolescence undernourished, making them more vulnerable to disease and early death. Girls constitute a more vulnerable group, especially in developing countries where they traditionally marry at an early age and are exposed to greater risk of reproductive morbidity and mortality.[8] Studies show that many children in low- and middle-income countries enter adolescence stunted and thin. Many are also anemic, and there are also a wide variety of other micronutrient deficiencies.[9]

Nutrition-related deficiencies in Eastern African countries including Ethiopia are on par with Asian countries.[10] The prevalence of wasting (thinness) among adolescent girls was 26% and 49.7% in two Bangladeshi studies,[11,12] and 53.8% in India,[13] respectively. Another study carried out in India showed that prevalence of underweight, stunting, and thinness among adolescent girls was found to be 32.8%, 19.5%, and 26.7%, respectively.[14] In Turkey, the rates of being stunted, underweight, and overweight/obese were 4.4%, 5.0%, and 16.8%, respectively.[15] Ethiopia has one of the highest rates of malnutrition in Sub-Saharan Africa and faces acute and chronic malnutrition and micronutrient deficiencies.[16] Nutrition deficiencies at different childhood growth and developmental stages including adolescences are common in Ethiopia.[17] Girls are vulnerable to stunting and wasting during adolescence because this period is characterized by a growth spurt including sexual development, maturation, and the onset of menarche. All of these factors cause an increased demand for nutrients and make girls vulnerable to malnutrition and are compounded by socio-demographic and economic factors.[17,18]

In Ethiopia, adolescent girls age 15–19 years (29%) are most likely to be thin (body mass index (BMI) below 18.5 kg/m^2). Rural areas have a higher percentage of thin girls (25%) than in urban areas (15%). Conversely, the percentage of overweight or obese women is higher in urban areas (21%) than in rural areas (4%).[19] Studies conducted in different regions of Ethiopia reveal that the overall prevalence of stunting among the adolescent girls is 15.5%,[20] 20.2%,[21] 12.2%,[22] and 15%[23] in Tehuledere, Arsi, Adwa, and Babli districts, respectively. Likewise, the prevalence of thinness varies across different regions of Ethiopia. The prevalence of thinness among adolescent girls was 21.6%, 28%, 21.4%, and 14.8% in studies conducted in Babille district,[23] Bedlle,[24] Adwa,[22] and Arsi zone.[21]

Recently, socio-demographic factors and economic factors including adolescent's age, mother's age, eating habits, place of residence, income, parents' occupation, literacy level, and cultural factors are associated with the nutritional status of adolescents.[25–27] This is mainly due to nutrition, epidemiologic, and socio-demographic transition across the world.[28,29] Socio-economic status was found to be associated with nutritional status of US adolescents.[30] In a study conducted in Kenya, the level of maternal education was found to be associated with the nutritional status of children. This implies that the ability of mothers to care for their children is high among literate mothers.[31] Nutritional status of the adolescent was low in both urban and rural adolescents, but severe thinness was higher among rural (39.3%) compared to urban (37.5%) adolescents in a study conducted in Babille district, Eastern Ethiopia.[23]

A significant association between malnutrition and socio-economic parameters was observed in a study conducted in Bangladesh. In this study, socio-economic status, maternal working status, family type, and family size were important determinants of nutritional status of adolescents.[32] The prevalence of thinness was also 37.8% and 58.3% in a study conducted in the rural community of Tigray and Mekelle city.[32,33] A study conducted in India, South Ethiopia, Ambo, Tigray, and Northwest Ethiopia revealed that age is independently associated with nutritional status of adolescent girls.[13,24,34–36] Family size was also found to be another predictor of nutritional status of adolescents in a study conducted in Bangladesh and Southwest Ethiopia.[12,24]

In developing countries like Ethiopia, community culture is also associated with the nutritional status of girls.[37] For example, girls in some societies are expected to feed last and feed least which increases nutritional needs during the adolescent stages yet again.[38]

Adolescent nutrition is given less attention to nutrition policies, strategies, and programs in low-income countries. Improved nutrition is the second of the Sustainable Development Goals. Moreover, targeting adolescent girls only when they are pregnant is often too late to break the intergenerational cycle of malnutrition.[39] Despite the fact that the health sector (including the Ethiopian Ministry of Health) has increased its efforts to enhance good nutritional practices through health education, treatment of extremely malnourished children, and provision of micronutrients for mothers and children, malnutrition is still a challenge in the area.[40]

Lay Guyint is a woreda in the South Gondar Zone, Amhara Region, Ethiopia. The altitude of this woreda varies from 1500 to 3100 m above sea level. The main staple foods are potatoes, beans, peas, and barley. The annual rainfall is erratically distributed and varies from 400 to 1100 mm.[30,41] In response to this, the purpose of this study was to explore the relationship between socio-demographic and/or economic factors and nutritional status of adolescent girls in high schools and preparatory schools in Lay Guyint Woreda, Northwest Ethiopia.

Materials and methods

Study area and period

The study was conducted in secondary and preparatory schools in Lay Guyint Woreda from 15 November to 15 December 2015. Lay Guyint Woreda is found at a distance of 711 km from

the capital city of Ethiopia, Addis Ababa, and 175 km from the capital town of Amhara region, Bahir Dar city.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board of Debre Tabor University. Following the approval, an official letter of cooperation was given to the school's directors and homeroom teachers. Permission was obtained from the school's directors prior to the study. The purpose and importance of the study were explained to the study participants and homeroom teachers (legally authorized representatives of the study participants). Overall data were collected only after fully written informed consent was sought from the homeroom teachers and verbal consent was obtained from study participants. All findings were kept confidential. The names and address of the participants were not recorded on the questionnaire.

Study design and participants

The institutional-based cross-sectional design was employed. The participants of the study were female adolescents in secondary and preparatory school who were randomly selected from all female adolescents (10–19 years old) in the Lay Guyint secondary and preparatory schools. From the selected participants, adolescent girls aged 10–19 years and available at the time of data collection were included in the study, and adolescent girls who had deformed anthropometric appearances and were seriously ill at the time of data collection were excluded from the study.

Sample size determination and sampling technique

The single proportion formula was used to determine the sample size by using a proportion of malnutrition in adolescent girls 31.5%[36] and a confidence level of 95% with a 5% margin of error ($(n = (Z_{\alpha/2})^2 \ p(1-p)/d^2)$; where, n = sample size, $Z\alpha/2 (1.96)$ = significance level at $\alpha = 0.05$); p = expected prevalence or proportion of malnutrition in adolescents = 0.315, d = margin of error (5%) = 0.05 with a 10% non-response rate, the final sample size was 362. Simple random sampling technique with proportional allocation to size was employed to select the study participants. All secondary and preparatory schools in Lay Guyint Woreda were taken for this study. According to the Woreda Education Bureau report, the woreda has three secondary and one preparatory school with a total of 7285 students. Among them, 3727 are girls. There are 1958, 373, 568, and 828 girls in Nefasmewucha Secondary School, Zagot Secondary School, Sali Secondary School, and Nefasmewucha Preparatory School, respectively. So, when the 362 sample adolescent girls were divided proportionally, 190, 36, 55, and 81 girls were taken from Nefasmewucha,

Zagot, and Sali Secondary Schools, and Nefasmewucha preparatory School, respectively.

Measurements and data collection techniques

A structured questionnaire was adapted from similar literature[11,20–22] and modified to suit the local context and was used to collect data on socio-demographic characteristics, meal patterns, meal skipping, and frequency of meals. Nutritional status of study subjects was assessed by performing the anthropometric assessment. Two[2] diploma nurses and two[2] BSc nurses served as data collectors and supervisors, respectively. After the participants were selected by the inclusion criteria, the data were collected by face-to-face interviews and through conducting the anthropometric assessment.

Anthropometric measurement

Height and weight were measured using a stadiometer and Seca digital scale (Seca Germany). Weight was measured using a portable standing scale, which has the ability to measure weight from 0 to 150 kg. The weight was recorded to the nearest 0.1 kg. It was regularly calibrated against a known weight. During the procedure, the subjects wore light clothes and took off their shoes. Height was measured in cm using a portable stadiometer. All girls were measured against the wall without footwear and with heels together and their heads positioned and eyes looking straight ahead (Frankfurt plane) so that the line of sight was perpendicular to the body. The height was recorded to the nearest 0.1 cm. The same measurer was employed for a given anthropometric measurement to avoid variability. Stunting was defined as adolescent girls with height-for-age Z-score < –2 SD from the median value of WHO's 2006 reference data.[42] Thinness (wasting) was defined as adolescents with weight-for-height Z-score < –2 SD from the median value of WHO's 2006 reference data.[42]

Data quality assurance and management

The data collectors and supervisors were trained intensively for 2 days about the purpose of the study, the sampling procedure, anthropometric measurement skills, and general approaches to the participants. Prior to data collection, the principal investigators shared ethical issues and ways of addressing contingency management skills. The English version of the questionnaire was translated by English linguistics to Amharic and again to English to ensure consistency. Anonymous data were checked for completeness every day by the supervisors and the principal investigators. All completed questionnaires were checked for completeness and cleaned manually.

Data processing and analysis

The questionnaires were coded and entered into EPI info version 3.5.3 statistical software and then exported to SPSS version

20 for Windows for further analysis. Data were summarized and presented using descriptive statistics. An anthropometric measurement was converted to the indices of nutritional status (the Z-scores of heights for age and BMI for age) using WHO Anthro Plus version 1.0.3 software.[43] The anthropometric analysis determined the proportion of adolescents who were stunted (height-for-age Z-scores ≤ −2 SD) and thin (BMI for age Z-score < −2 SD).[43] The outcome variables were coded as "1" for having thinness or stunting whereas "0" for not having these problems. The association between the outcome variables (i.e. stunting and thinness) and independent variables were first analyzed using a bivariate logistic regression model. Covariates having a p-value < 0.25 were retained and entered into the multivariable logistic regression analysis using forward stepwise approach methods.[44] The results are presented as odds ratios (OR) with 95% confidence intervals (CIs). A p-value < 0.05 was considered as a cut-off point for an independent variable to be significantly associated with the outcome.

Result

Socio-demographic characteristics of the study subjects

A total of 362 participants were interviewed yielding a response rate of 100%. The mean (SD) ages were 14.8 (±1.34) years. Of the participating adolescents, 281 (77.6%) were living in rural areas. Nearly all (98.1%) of the participants were Amhara by ethnicity, and 93.6% of them were Orthodox by religion. Concerning the educational status of the adolescent girls, most (62.7%) were in grades 11 and 12 (Table 1).

Dietary habit and food items consumed

Nearly all participants (97%) ate cereal-based foods for at least 5 days per week, while 9.7% ate vegetables for less than 5 days per week. Correspondingly, the majority (98%) of the participants had snacks. Two hundred sixty-four (72.9%) ate three times per day (Table 2).

Prevalence of stunting and thinness

The overall prevalence of stunting and thinness were 16.3% (95% CI: 12.5%, 20.1%) and 29.0% (95% CI: 24.4%, 33.6%), respectively. The mean ± SD of the overall height of the participants was 156.46 ± 10.07 cm (95% CI: 146.5, 148.8) and weight was 44.01 ± 8.90 kg (95% CI: 36.2, 38.2). Height-for-age Z-scores and BMI for age Z-score of the participants were −0.95 (±0.1.108) Z-score, and −0.10 (± 1.176), respectively, (Figures 1–3).

Factors associated with the nutritional status of adolescent girls

In the multiple logistic regression, the age of adolescent girls, place of residence, having snacks, and mother's occupational

Table 1. Socio-demographic characteristics of adolescent girls in high schools and preparatory school of Lay Guyint Woreda, Northwest Ethiopia (n = 362), 2015.

| Variable	Frequency	Percent
Age of the adolescents (years)		
10–13	14	3.9
14–15	155	42.8
16–19	193	53.8
Marital status		
Single	346	95.6
Married	16	4.4
Religion		
Orthodox	340	93.6
Muslim	22	6.1
Place of residence		
Urban	81	22.4
Rural	281	77.6
Educational status of girls (grade)		
9–10	135	37.3
11–11	227	62.7
Family monthly income (ETB)		
<1000	224	61.9
1000–2000	54	14.9
2001–3000	67	18.5
>3000	17	4.7
Mother's occupational status		
Farmer	279	77.1
Government employee	51	14.1
Other[a]	32	8.8

[a]Merchant, student, daily laborer.

status were independently associated with stunting. Adolescents aged 14–15 years were 3.65 times more likely to be stunted (AOR = 3.65; 95% CI: 1.87, 7.11). Adolescents living in rural areas were 1.34 times more likely to be stunted (AOR = 1.34. 95% CI: 1.24, 2.33). Adolescents who did not have a snack were 11.39 times more likely to be stunted (AOR = 11.39; 95% CI: 1.47, 17.8). Mother's occupation was negatively associated with stunting. The proportion of stunting was 88% less among adolescents whose mother's occupation was merchant, student, or daily laborer (AOR = 0.12; 95% CI: 0.17, 0.87) (Table 3).

Likewise, place of residence, age, mother's occupational status, and educational status of adolescent girls were significantly associated with adolescent thinness on multivariable logistic regression. Rural residents had 2.40 times higher odds of being thin (AOR = 2.40; 95% CI: 1.13, 5.08) than urban adolescents. Adolescents aged 14–15 years were 6.05 times more likely to be thin (AOR = 6.05; 95% CI: 2.15, 17.04). The mother's job was positively associated with thinness. An adolescent whose mother is a farmer has 5.27 times higher odds of being thin (AOR = 5.27; 95% CI: 5.41, 19.92). On the contrary, the educational status of adolescent girls was negatively associated with thinness. The proportion of thinness was 87% less among adolescents who were in grades 9 and 10 (AOR = 0.13; 95% CI: 0.05, 0.35) (Table 4).

Table 2. Dietary habit and food items consumed by female adolescent girls in high school and preparatory schools of Lay Guyint Woreda, Northwest Ethiopia (n = 362), 2015.

Variable	Frequency	Percent
Eating cereals		
<5 days	11	3.0
≥5 days	351	97.0
Eating vegetables		
<5 days	327	90.3
≥5 days	35	9.7
Eating fruits		
<5 days	353	97.5
≥5 days	9	2.5
Eating animal-based foods		
<5 days	336	92.8
≥5 days	26	7.2
Number of meals per day		
3 times	264	72.9
≥4 times	98	7.2
Having a snack		
Yes	356	98.3
No	6	1.7
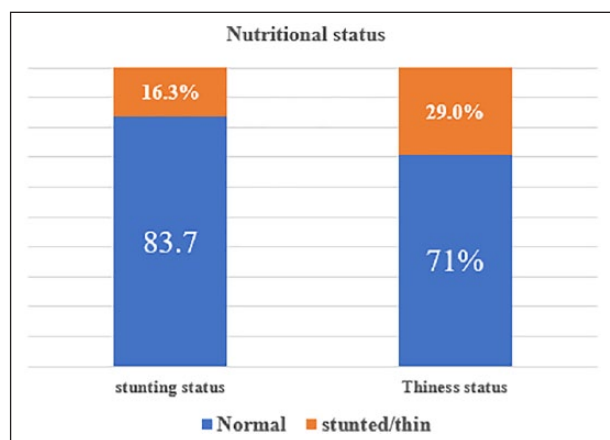
Figure 1. Nutritional status of adolescent girls in high school and preparatory schools of Lay Guyint Woreda, Northwest Ethiopia (n = 362), 2015.

Discussion

The findings from this study show that 16.3% (95% CI: 12.5%, 20.1%) of adolescent girls were stunted. This finding is in line with a study conducted in Bible district, Eastern Ethiopia (15%),[23] Tehuledere district (15.5%),[20] and the Bangladeshi study (15.5%).[11] But it is higher than the findings from Turkey (4.4%),[15] Addis Ababa (7.2%),[45] and Mozambique (2.3%).[26] This is probably due to the difference in the socio-economic and socio-demographic characteristics since people in Turkey and Addis Ababa are higher than those in our study area in terms of socio-economic status. Nevertheless, it was lower than studies conducted in India

(19.5%),[46] Bangladesh (32%),[12] two northern Ethiopia studies (28.5%)[47] and (31.5%),[36] and in Tigray (26.5%).[35] This might be due to the variation in sample size, which increases the proportion of stunting.

Correspondingly, the findings from this study show that 29% (95% CI: 24.4%, 33.6%) of adolescent girls were thin. This finding is consistent with a study conducted in Bangladesh (26%),[12] India (26.7%),[48] and Northern Ethiopia (26.1%).[47] However, the study is higher than studies conducted in Bible district, Eastern Ethiopia (21.6%);[23] Benue State, Nigeria (11.5%);[27] Adwa town (21.4%);[22] Northwest Ethiopian study (13.6%);[36] and low-income countries (6.3%).[49] This might be due to the fact that there is a difference in barriers to undernutrition such as cultural differences and other socio-demographic characteristics. Still, it was lower than studies conducted in Tigray (37.8%);[35] Kano, Northwestern Nigeria (60.6%);[50] and Kashmir Valley (35%).[51] This is possibly due to the difference in the study area and sample size. The study of Kano and Northern Ethiopia, and Kashmir Valley used a small sample size, which may have led to an increased estimation of the proportion of thinness. On the contrary, the Indian study was hospital-based which may have increased the prevalence of thinness (wasting) due to illness. Again, the study in Tigray was conducted in a rural area, which is predisposed to a high prevalence of thinness among adolescents.

In this study, an adolescent from rural areas was about 1.34 times more likely to be stunted. A study conducted in India,[13] Ambo,[34] and Babille district[23] showed similar findings. This might be due to the low socio-economic/demographic characteristics of the rural residents as compared to urban dwellers. The findings also showed that adolescent age was significantly associated with stunting. Those adolescents aged 14–15 years were about four times more likely to be stunted as compared to early adolescents (10–13 years) and those aged 16–19 years. This finding is supported in studies conducted in Bangladesh,[11] Tehuledere,[20] two Northern Ethiopian studies,[36,47] Mozambique,[26] Ambo,[34] South Ethiopian study,[24] and Tigray.[24] This could be due to the fact that this age group is characterized by a spurt of growth in which there is rapid physical, emotional, social, sexual, and psychological development, and maturation. About 20% of the total growth in stature and 50% of adult bone mass are achieved during the adolescent period. Consequently, the nutrient requirements are significantly increased as compared to those in childhood years. So, if the requirements and supply are not balanced, the adolescent girls may be exposed to stunting.[52] Having a snack is also positively associated with stunting in adolescent girls. Those adolescents who did not have snack were about 11 times more likely to be stunted. This is probably due to the high requirement of nutrient needs during the adolescent period, which demands additional meal frequency in addition to the usual diet of breakfast, lunch, and dinner.[53] However, mother's occupation was negatively associated with stunting. The proportion of stunting was 88% less among adolescents
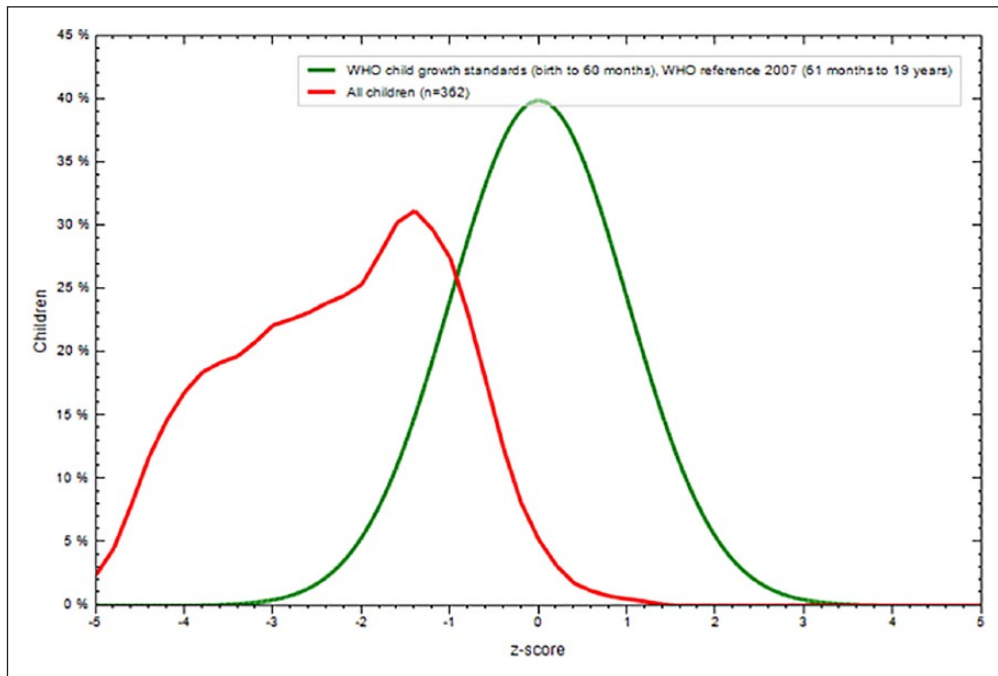
Figure 2. Height for age Z-score comparison of WHO reference and adolescent school girls Northwest Ethiopia (n = 362), 2015.
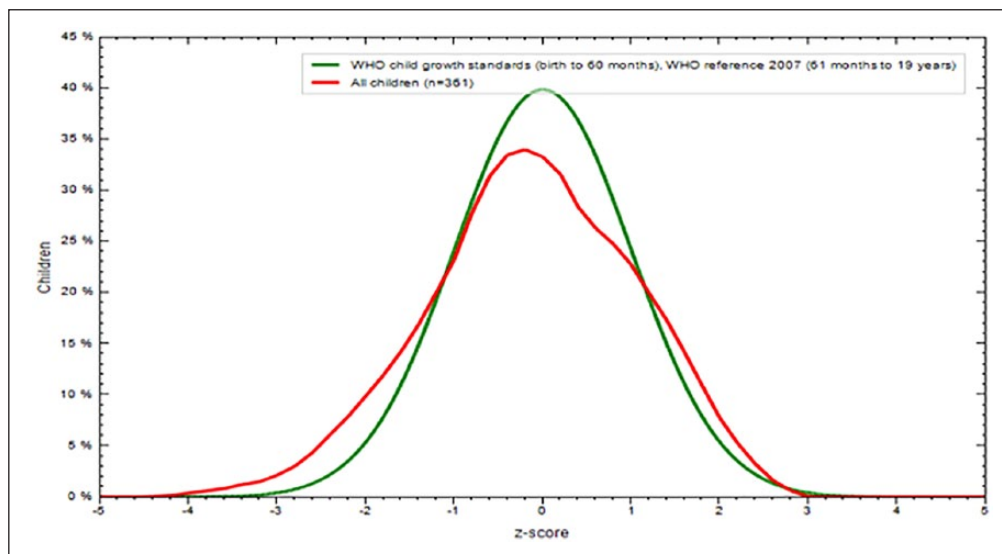
Figure 3. BMI for age Z-score comparison of WHO reference and adolescent school girls Northwest Ethiopia (n = 362), 2015.

whose mother's job was merchant, student, or daily laborer. This might be due to the fact that mothers who are merchants, students, or daily laborers are always busy because of the nature of their job. Besides, such kinds of occupation may be predisposed to childhood stunting. As a result, adolescent height is also affected by pre-existing childhood stunting.[54]

Concerning the factors associated with thinness among adolescent girls, adolescents aged 14–15 years were about six times more likely to be thin as compared to other age groups. This might be due to the fact that adolescents in this age group are taking on adult roles, especially in developing countries like Ethiopia. Eating disorders are also common during the adolescent period, and this may predispose acute malnutrition such as stunting. Moreover, this age group is undergoing a growth spurt, so the physiological demand for macronutrients and micronutrients is high. Adolescent girls gain 20% of adult height and 50% of adult weight during the growth spurt leading to an increased BMI. But if they cannot get adequate food at this age, their BMI tends to decrease and they become thin.[55]

Table 3. The association between stunting and its determinants among adolescent girls in secondary and preparatory school of Lay Guyint Woreda, Northwest Ethiopia (n = 362), 2015.

Variables	Stunting status		OR (95% CI)	
	Normal	Stunted	COR (95% CI)	AOR (95% CI)
Age of the adolescents (years)				
10–13	10	4	3.66 (1.047, 12.8)	6.29 (1.59, 24.85)
14–15	119	36	2.77 (1.51, 5.06)	3.65 (1.87, 7.11)[a]
16–19	174	19	1.00	1.00
Place of residence				
Urban	63	18	1.00	1.00
Rural	240	41	1.94 (1.28, 2.93)	1.34 (1.24, 2.33)[a]
Occupational status of the mother				
Farmer	225	54	0.67 (0.52, 1.71)	0.34 (0.19, 2.71)
Government employee	49	2	1.00	1.00
Other[b]	29	3	0.46 (0.243, 0.88)	0.120 (0.17, 0.87)[a]
Eating animal source foods				
<5 days	287	49	0.27 (0.12, 0.63)	0.25 (0.101, 0.66)
≥5 days	16	10	1.00	1.00
Number of meals per day				
3 times	218	46	1.38 (0.71, 2.68)	0.23 (0.12, 1.22)
≥4 times	85	13	1.00	1.00
Having a snack				
Yes	258	58	1.00	1.00
No	41	5	9.07 (1.22, 24.67)	11.39 (1.47, 17.1)[a]

OR: odds ratio; CI: confidence interval; COR: crude odds ratio; AOR: adjusted odds ratio.
[a]Significantly associated with stunting.
[b]Merchant, student, daily laborer.

In this study, rural residents had about two times higher odds of being thin than urban adolescents. It could be surmised that rural areas are more prone to hygiene-related diseases; for example, poor sources of water may lead to malnutrition (thinness). Moreover, rural adolescents and their parents may have poor knowledge of dietary diversity.[56] The mother's occupational status was also significantly associated with thinness. Adolescents whose mothers were farmers had five times higher odds of being thin as compared to the other occupational status, such as government employer, merchant, student, and daily laborer. This could be due to the fact that a lack of knowledge about diet and social factors such as food taboos are common among the Ethiopian farmers, and mothers are also part of this community. Besides, most of the farmers in the Ethiopian communities have food insecurity, inadequate social and care environment, and inadequate access to health services and environmental factors, such as poor water and sanitation facilities. All these are the underlying causes of malnutrition across different age groups of childhood and adolescents.[57] On the contrary, the educational status of adolescent girls was negatively associated with thinness. The proportion of thinness was 87% less among adolescents who were in grades 9 and 10 as compared to those who were in grades 11 and 12. This could be explained by the idea that the nutrition-related knowledge and attitude in the school needs emphasis as part of adolescent care.[1]

However, the present study does have some inherent limitations. Due to the lack of available food list by considering seasonal variation, the detailed dietary assessment as a complement of anthropometric measurements was not included. It also lacks a laboratory nutritional assessment of adolescents due to financial constraints. Furthermore, the direction of the association between socio-demographic and/or economic factors varies from location to location. Therefore, extrapolating these results to other rural populations in Ethiopia may be difficult.

Conclusion

The study suggested that stunting and thinness are prevalent among adolescent girls in secondary and preparatory schools in Lay Guyint Woreda. The age of adolescents, place of residence, and having a snack was positively associated with stunting. Likewise, the age of adolescents, place of residence, and mother's job was positively associated with the thinness of adolescent girls. Girls may be at significantly higher risk of malnutrition due to different socio-demographic and economic factors. As girls are future mothers, this may have a negative effect that perpetuates the intergenerational cycle of malnutrition. Therefore, more attention should be given to those adolescents aged 14–15 years during this adolescent growth spurt period. Having a snack at least one time in addition to the usual diet is strongly recommended. For researchers, carefully designed longitudinal studies are needed to identify

Table 4. The association between thinness and its determinants among adolescent girls in secondary and preparatory schools in Lay Guyint Woreda, Northwest Ethiopia (n = 362), 2015.

Variables	Thinness status		OR (95% CI)	
	Normal	Thin	COR (95% CI)	AOR (95% CI)
Age of adolescent				
10–13	5	9	6.09 (1.94, 19.13)	
14–15	103	52	1.71 (1.06, 2.74)	6.05 (2.14, 17.04)[a]
16–19	149	44	1.00	1.00
Place of residence				
Urban	61	20	1.00	
Rural	196	85	1.32 (0.75, 2.32)	2.402 (1.13, 5.08)[a]
Educational status of girls				
9–10	106	29	0.54 (0.31, 0.89)	0.132 (0.049, 0.355)[a]
11–12	151	76	1.00	1.00
Occupational status of mothers				
Farmer	185	94	3.53 (1.20, 10.38)	5.29 (1.406, 19.92)[a]
Government employee	44	7	1.00	1.00
Others[b]	28	4	1.14 (0.30, 4.25)	
Eating animal source foods				
>5 days	241	95	0.63 (0.27, 1.43)	1.09 (0.60, 1.99)
≥5 days	16	10	1.00	1.00
Number of meals per day				
3 times	183	81	1.36 (0.80, 2.31)	0.92 (0.24, 3.52)
≥4 times	74	24	1.00	1.00
Having a snack				
Yes	237	83	0.31 (0.165, 0.61)	0.32 (0.54, 1.91)
No	20	22	1.00	1.00

OR: odds ratios; CI: confidence interval; COR: crude odds ratio; AOR: adjusted odds ratio.
[a]significantly associated with thinness.
[b]merchant, student, daily laborer.

the reasons for poor growth throughout the period of adolescence in this population.

Author contributions

G.A. designed the study, performed the statistical analysis, and drafted the manuscript. M.A. and T.W. participated in the study design and statistical analysis. T.W. and M.A. drafted the manuscript. All authors contributed their intellectual inputs, and read and approved the final version of the manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical clearance was obtained from the Institutional Review Board of Debre Tabor University (ref. no. DTU/RP/188/15). Following the approval, an official letter of cooperation was given to the school's directors and homeroom teachers.

Informed consent

After the approval of the study by the Institutional Review Board, permission was obtained from the school's directors prior to the study. The purpose and importance of the study were explained to the study participants and homeroom teachers (can act as legally authorized representatives of the students in the school). Meanwhile, there are no handy list of substitutes that can be relied on with certitude. Overall data were collected only after fully written informed consent was sought from the homeroom teachers and verbal consent was obtained from study participants without pressure from the

homeroom teachers or investigators. All findings were kept confidential. The names and address of the participants were not recorded on the questionnaire.

ORCID iD

Teshager Worku https://orcid.org/0000-0002-6153-7819

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