BMJ Open

Prevalence and correlates of stunting and thinness among adolescent students in Lideta subcity, Addis Ababa, Ethiopia: a cross-sectional study

Genanew Kassie Getahun [ID],[1] Alebachew Assfaw,[1] Esmael Ali Muhammad [ID],[2] Tewoderos Shitemaw [ID] [1]

[1]Kotebe Metropolitan University, Menelik II Medical and Health Science College, Addis Ababa, Ethiopia
[2]Department of Human Nutrition, Institute of Public Health, University of Gondar, Gondar, Ethiopia

Correspondence to
Genanew Kassie Getahun; genanaw21kassaye@gmail.com

ABSTRACT

Objectives To determine the prevalence of stunting and thinness and associated factors among adolescents attending public schools in Lideta subcity, Addis Ababa, Ethiopia, in 2021.

Design Cross-sectional.

Setting Public schools in Lideta subcity, Addis Ababa, Ethiopia.

Eligibility Adolescents from grades 5–12 in public schools and students whose parents gave consent for participation.

Data analysis Bivariate and multivariable logistic regression analyses were used to examine the association between the independent variables and stunting and thinness. Using a 95% CI and adjusted OR (AOR), factors with a p value of less than 0.05 were determined to have a significant association.

Outcome measures The prevalence of stunting and thinness, as well as the factors associated with stunting and thinness, were secondary outcomes.

Results The overall prevalence of stunting and thinness was 7.2% (95% CI: 5.3% to 9.3%) and 9% (95% CI: 6.8% to 11.4%), respectively. Stunting was associated with a larger family size (AOR=3.76; 95% CI: 1.58 to 8.94), low dietary diversity (AOR=2.87; 95% CI: 1.44 to 5.74), food insecurity (AOR=2.81; 95% CI: 1.38 to 5.71) and a lower wealth index (AOR=3.34; 95% CI: 1.51 to 7.41). On the other hand, thinness was associated with maternal education in those who were unable to read and write (AOR=2.5; 95% CI: 1.97 to 8.11), inadequate dietary diversity (AOR=4.81; 95% CI: 2.55 to 9.07) and larger family size (AOR=2.46; 95% CI: 1.14 to 5.29).

Conclusion Adolescent stunting and thinness were common in Addis Ababa's public schools. Family size, dietary diversity and food security were the main factors associated with both thinness and stunting. Therefore, to solve the problem of adolescent stunting and thinness, the administration of Addis Ababa city should prioritise minimising food insecurity while boosting productivity to enhance adolescent nutritional diversity. Moreover, nutritional education should be strengthened by healthcare providers working at public schools as well as health extension workers.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study had a larger sample size (678) and a maximum response rate (100%).
⇒ The study used a cross-sectional study design, which does not establish a causal relationship between the outcome variable and independent factors.
⇒ The findings of this study might be affected by recall and social desirability bias.

INTRODUCTION

According to the WHO, adolescence is defined as the period from 10 to 19 years during which an individual undergoes major physical growth, mental development and psychological changes.[1 2] There are nearly 1.3 billion adolescents worldwide, accounting for 16% of the global population.[3] Particularly in Ethiopia, children and adolescents make up around 48% of the overall population.[4] Adolescents gain up to 50% of their adult weight, more than 20% of their adult height and 50% of their adult skeletal mass as a result of increased dietary needs.[5]

Suboptimal nutrition during this period leads to undernutrition, which has consequences for their health and sexual development.[6] In low/middle-income countries, malnutrition, particularly undernutrition, is very common among adolescents.[7 8] In a study that examined the global trend in 24.1 million children's nutritional status between the ages of 5 and 17 years, it was shown that the prevalence of underweight had decreased in all but South Asia, Central Africa, East Africa and West Africa.[9] Since both undernutrition and overnutrition coexist in the majority of sub-Saharan African countries, including Ethiopia, they are facing a phenomenon called the 'double burden of malnutrition'.[10] Moreover, the prevalence of stunting and thinness in developing nations among adolescents ranges from 32% to

48%,[11 12] particularly in Ethiopia, where it was reported to be 7.2%–26.5%.[13]

The triple burden of malnutrition includes undernutrition (underweight, stunted or wasted), micronutrient deficiency, and overweight and obesity (weight that is greater than what is considered healthy for one's height).[14] Undernutrition in adolescence manifests as stunting and thinness, which have the potential to reduce learning capacity, delay sexual maturation, cause inattentiveness, impede academic performance, weaken physical and economic progress, restrict the body's capacity to absorb nutrients properly and prolong poverty.[15–17]

Undernutrition in adolescents is best measured by two major indicators: the low BMI (body mass index) for age, which is less than 2 SD, and stunting, which is the low height for age, which is less than 2 SD.[18] Adolescents' nutritional status is affected by a variety of circumstances. The key determinants are socioeconomic status, age, sex, household income, marital status, family size, maternal education, food insecurity, dietary diversity, patterns and habits.[19 20]

Undernutrition during the adolescent period diminishes the working capacity of an individual during adulthood.[21 22] Ultimately, it silently destroys the future socioeconomic development of a nation and even causes the cruel cycle of intergenerational undernutrition by causing parents to share the consequences with their children, including low birth weight, short stature and low resistance to infection.[23–25] This problem would be devastating in Ethiopia, where about 27.7% of adolescent girls become pregnant at the age of 19 years.[26]

Ethiopia has been working to reduce the high burden of undernutrition through the implementation of national programmes like the National Nutrition Program, including school feeding programmes (SFPs), for the past 3 years in Addis Ababa. As far as our knowledge is concerned, this is the first study since the start of the public SFP. Therefore, the study aims to assess stunting, thinness and associated factors among adolescents in Lideta, a subcity of Addis Ababa, Ethiopia, in 2021.

METHODS

Study area and period

The study was conducted in Lideta, a subcity of Addis Ababa, Ethiopia. Lideta subcity is 1 of the 11 subcities of Addis Ababa city administration, located in the central part of the town. Information obtained from the Lideta subcity educational office reported that there were 18 primary schools and 3 secondary schools. In the academic year 2020–2021, around 10 033 adolescents were registered. Of these, 3431 were in secondary schools, and the rest were in primary schools.

In Addis Ababa, a large-scale SFP was launched in February 2019 with the goal of feeding kids in public elementary schools to reduce hunger in the classroom. The education bureau of the Addis Ababa municipal administration owns and funds the Addis Ababa SFP, which provides two meals for students each day (breakfast and lunch each school day). Throughout the course of a week, the food menu comprises of a total of 11 different food types and items served for both breakfast and lunch. The school lunch consists of rice, bread, marmalade, shiro-based fir-fir, potato-based sauce, white bread (difo), injera, refined bread, tea and boiled eggs. All of the public elementary schools in Addis Ababa provide identical school lunches.[27] The study was conducted from 20 May to 5 June 2021, using an institution-based cross-sectional study design.

Source population

All adolescent students in public schools enrolled in Lideta subcity, Addis Ababa, Ethiopia.

Study population

All school-aged adolescents enrolled within randomly selected primary and secondary schools in Lideta subcity, Addis Ababa, Ethiopia.

Eligibility criteria

Inclusion criteria

Adolescents from grades 5–12 in the selected public schools and students whose parents gave consent participated in the study.

Exclusion criteria

Those adolescents from public schools who were seriously ill or absent for any reason during the data collection period were excluded from the study.

Sample size determination **and sampling procedure**

The sample size was calculated using the single population proportion formula:

$$n = \frac{\left(Z_{\frac{\alpha}{2}}\right)^2 P(1-P)}{d^2}$$

The magnitude of stunting and thinness from the previous studies was considered 20.7% and 22%,[17 28] with a precision of 4%, a 95% CI, a design effect of 1.5, and after adding a 10% non-response rate, the maximum sample size was 678.

For this study, seven primary and two secondary schools were selected using simple random sampling techniques among the 18 primary and 3 secondary schools that were located in Lideta subcity. Each school and class (grades 5–12) found in each selected school received a proportional allocation of the sample size. Each school's administrators provided a sampling frame (a list of adolescents aged 10–19 years). Finally, a simple random sample strategy was used to pick study participants by using the student list as a sampling frame.

Study variables

The presence or absence of thinness as defined by having a BMI-for-age (BAZ) value less than 2 SD from the WHO child growth standard and stunting as measured by a height-for-age (HAZ) value less than 2 SD from the WHO

Table 1 Sociodemographic characteristics of adolescent students in public schools in Lideta subcity, Addis Ababa, Ethiopia (n=678)

Variables	Category	Frequency	Per cent
Sex	Male	364	53.7
	Female	314	46.3
Adolescents' age	10–13	219	32.3
	14–16	296	43.7
	17–19	163	24
Adolescents' grade	Primary school	446	65.8
	Secondary school	231	34.1
Fathers' educational status	Unable to read and write	77	11.4
	Able to read and write	233	34.4
	Primary education	147	21.7
	Secondary education	106	15.6
	College and above	84	12.4
Mothers' education	Unable to read and write	85	12.5
	Able to read and write	147	21.7
	Primary education	167	24.6
	Secondary education	100	14.8
	College and above	80	11.8
Family size	<3	204	30.1
	4–5	217	32
	>5	257	37.9
School feeding programme	Yes	446	65.8
	No	232	34.2

Primary school consists of grades 5–8, and secondary school includes grades 9–12.

child growth standard were considered as outcome variables of this study. Besides, sociodemographic characteristics such as age, wealth index (poor, middle, wealthy), family size (3, 4–5, >5), parents' education (unable to read and write, able to read and write, primary education, secondary education, college and above), dietary diversity (good, poor) and environmental factors such as having a toilet (absence, presence) were all used as independent variables.

Data collection methods and procedures

Four diploma nurses and two BSc health officers were hired as data collectors and supervisors, respectively. Data were collected through a face-to-face interview using a structured and pretested questionnaire. The data collection began with the permission and consent of students' parents at their residence. The parents were asked on sociodemographic factors, food security, wealth index, environmental sanitation and hygiene in their home. Questionnaire-administered interviews with all of the

parents (mothers or fathers) of students were conducted at their homes in the afternoon as soon as the children arrived home. The remaining individual dietary information was obtained from the adolescent.

The questionnaire for this study was adopted from the EDHS (Ethiopian Demographic Health Survey)[19] and reviewed in the literature of similar studies.[7 8 18] The tool contains sociodemographic, nutritional, environmental and dietary factors.

Height measurement
Setting up the measurement site
The height was measured with a stadiometer applied vertically to a hard, flat wall surface, with the base at floor level. The vertical location of the rule was checked with a carpenter's level. In the absence of such a floor, a hard wooden platform was placed beneath the high base.

Setting up the measurement site
It was measured by a weighing scale (model 8811021659, made in Germany). The weighing balance was calibrated in kilograms, and students were weighed to the nearest 0.1 kg while dressed in light clothing and without shoes.

Measuring the Dietary Diversity Score
The Dietary Diversity Score (DDS) was used to assess nutritional adequacy, which was defined as the number of food categories ingested in a certain period of time, often 24 hours. Each respondent was asked about the food they had eaten the previous day, both at home and away from it. Among those who consumed at least four different food groups the day before, minimal dietary diversity was obtained from eight different food categories (24-hour recall). The DDS of eight food categories (grains (white roots, tubers and plantains), pulses (beans, peas and lentils), nuts and seeds, dairy and eggs, dark green leafy vegetables, vitamin A-rich fruits and vegetables, vegetables and fruits) was used, and it was calculated by taking into account the type and number of food groups consumed by the households.[23] Poor dietary diversity was defined as a DDS below the median value (less than four food groups), and good dietary diversity was categorised as adolescents who had a DDS at or above the median value (greater than or equal to four food groups).[28]

Measuring food insecurity in households
The Household Food Insecurity Access Scale (HFIAS) developed by FANTA was used to determine the level of food insecurity in the household. The scale explores the occurrence and frequency of occurrence of nine food insecurity-related events in the past 30 days of the survey. The household was classified as either food secure or food insecure by the HFIAS.[29]

The wealth index procedure
Questions from the 2016 EDHS were used to determine the wealth level of the households.[19] Fourteen major variables (mobile phone, radio, chairs, tables, television, watch, jewellery, car, motorcycle, house, non-mobile telephone,

Table 2 Dietary diversity among adolescents in public schools in Lideta subcity, Addis Ababa, Ethiopia, 2021

Variable	Response	Frequency	Percentage
Grains, root or tuber	Yes	597	88.1
	No	81	11.9
Vitamin A-rich fruits and vegetables	Yes	401	59.1
	No	277	40.9
Fruits and vegetables	Yes	350	48.4
	No	328	51.6
Meat, poultry, offal and fish	Yes	193	28.5
	No	485	71.5
Eggs	Yes	199	70.6
	No	479	29.4
Pulses, legumes, nuts and seeds	Yes	257	37.9
	No	421	62.1
Milk and milk products	Yes	296	43.7
	No	382	56.3
Food cooked in oils and fats	Yes	532	78.5
	No	146	21.5

Vitamin A-rich fruits and vegetables include red, yellow and green leafy vegetables like carrots, cabbage, sweet potatoes, mangoes and papayas.

Table 3 Eating habits and frequency among adolescents in public schools of Lideta subcity, Addis Ababa, 2021

Variable	Category	Frequency	Percentage
Meal frequency	Once a day	12	1.8
	Two times a day	190	28
	Three times a day	323	47.6
	More than four times a day	152	22.6
Frequency of meat eating in a week	Never	134	19.8
	Once	166	24.5
	Two times	152	22.4
	Three times	117	17.5
	More than three times	109	16
Drink soft drinks in a week	Never	160	23.3
	Once	136	20.1
	Two times	180	26.5
	Three times	78	11.5
	More than three times	104	15.3
Drink citrus fruits in a week	Never	138	20.4
	Once	172	25.4
	Two times	256	37.8
	More than two times	112	16.5
Eat eggs in a week	Never	263	38.8
	Once	95	14
	More than two times	175	28.5
	Every day	143	21.4
Drink milk and milk products in a week	Never	235	34.7
	Once	185	27.3
	More than two times	125	18.4
	Once a day	133	19.6
Staple food in the family	Injera	495	72.7
	Bread	154	22.7
	Other	31	4.5

refrigerator, bed with cotton, sponge or spring mattress, and computer) were analysed. The values of each wealth variable were recoded as 0 and 1 before undertaking principal component analysis (PCA). Scores are assigned to households based on the number and types of consumer goods they own, including each durable good, from a television to a bicycle or car, as well as dwelling qualities like bathroom amenities and flooring materials. With the help of PCA, wealth index scores were created. By giving each household a score, rating each household according to that score and then splitting the distribution into three equal groups, each of which includes 33% of the population, the wealth quintiles were created. Following that, PCA was used to rank the findings from lowest to highest into three groups: poor, medium and wealthy, which were coded as 1, 2 and 3, respectively.

Operational definition

Thinness was taken as a BAZ value of less than 2 SD from the WHO child growth standard.[30]

Stunting was defined as an HAZ value of less than 2 SD from the WHO child growth standard.[30]

Poor dietary diversity: adolescents with a DDS below the median value of less than four food groups.[24]

Good dietary diversity: adolescents were measured using a qualitative recall of all foods consumed by each adolescent during the previous 24 hours through a standardised and validated tool containing eight food groups taken from verbal reports of the participants, and we considered

an adolescent to have adequate dietary diversity if they reported consuming four or more food groups.[11]

Food-secure household: a household with a score of 0–1 on the HFIAS is classified as food secure.[30]

Food-insecure households: based on an HFIAS score (0–27) of 2 and above, these households were considered food insecure.[31]

Quality assurance

In order to maintain the quality of the data, training was provided to data collectors and supervisors for 1 day by the principal investigators. The questionnaire was prepared first in English and then translated to the local language, Amharic, and back to English to check its consistency. A pretest was conducted on 5% of the subjects at Addis Ketema subcity public schools, and the scales were carefully handled and periodically calibrated by placing standard calibration weights of 2 kg iron bars on the scales.

Table 4 Proportion of thinness and stunting in relation to different variables in adolescents in public schools of Lideta subcity, Addis Ababa, 2021

Variables	Thinness		Stunting	
	Yes	No	Yes	No
Sex				
Male	40 (11%)	324 (89%)	31 (8.5%)	333 (91.5%)
Female	21 (6.7%)	293 (93.3%)	18 (5.7%)	296 (94.3%)
Age group				
10–13	17 (7.8%)	202 (92.2%)	18 (8.2%)	201 (91.8%)
14–16	26 (8.8%)	270 (91.2%)	15 (5.1%)	281 (94.9%)
17–19	18 (11.0%)	145 (89.0%)	16 (9.8%)	147 (90.2%)
Food security				
Secure	22 (5.8%)	359 (94.2%)	12 (3.1%)	369 (96.9%)
Insecure	39 (13.1%)	258 (86.9%)	37 (12.5%)	260 (87.5%)
Wealth index				
Poor	26 (11.3%)	205 (88.7%)	31 (13.4%)	200 (86.6%)
Middle	18 (8.7%)	189 (91.3%)	9 (4.3%)	198 (95.7%)
Wealthy	17 (7.1%)	223 (92.9%)	9 (3.8%)	231 (96.2%)
Dietary diversity				
Good	15 (3.9%)	374 (96.1%)	13 (3.3%)	376 (96.7%)
Poor	46 (15.9%)	243 (84.1%)	36 (12.5%)	253 (87.5%)

On-site supervision was performed, and each copy of the questionnaire was checked for completeness and accuracy before data entry.

Data processing and analysis

For cleaning, recoding and categorising variables, the collected data were entered into EPI Info V.3.1 computer program and exported to the SPSS V.21 for analysis. In addition, the WHO Anthro-Plus software was used to enter and analyse anthropometric data. PCA was used to examine the household wealth index. The Keiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were used to verify the statistical assumptions of factor analysis. As a result, a KMO of 0.5 or above, as well as a significant Bartlett's test of sphericity (p=0.05), were deemed sufficient to satisfy the assumption.

Moreover, communality values and eigenvalues of 0.5 and greater than 1 were included in the factor analysis. The variables with less than 0.5 of the communality value were removed from the analysis, and the analysis was repeated until all variables met the inclusion criteria for factor analysis. Next, all eligible factor scores were computed using the regression-based method to generate one variable, wealth status. Then, afterwards, the loading factors were sorted in ascending order. Following this, the final scores were ranked into three quartiles, namely first, second and third. Finally, ranks were interpreted as poor, medium and wealthy, respectively. A descriptive summary (frequency distribution, proportion, mean and SD) was used to summarise the variable.

Binary logistic regression analysis was used to ascertain the association between explanatory and outcome variables. A variable whose p value was less than 0.2 in the bivariate analysis was entered into the multivariable logistic regression analysis to determine factors associated with stunting and thinness. In the multivariable analysis, a p value of less than 0.05 and an OR with a 95% CI were used to declare the presence and strength of the association.

Patient and public involvement

Throughout the data collection period, parents or the legal guardians of the study participants and public school teachers were involved. However, they were not involved in the design, conduct, reporting, or dissemination plans of this research.

RESULTS
Sociodemographic characteristics of adolescents and their families

A total of 678 adolescent students were included in the study, with a 100% response rate. Males made up nearly half (364 or 53.7%) of the study participants. The average age of the respondents was 15 (SD 2.4) years, with a range of 11–19 years. Almost one-third (211 or 31.6%) of the study participants were early adolescents. The majority of participants (446 or 65.8%) were from primary schools. In terms of their parents' occupation status, nearly a quarter (173 or 25.5%) of their fathers and 158 (23.3%) of their mothers were government employees and housewives, respectively (table 1).

The dietary diversity status of adolescents

The mean (SD) DDS in the study group was 4.2.[2] The proportion of adolescents who consumed good dietary diversity was 389 (57.4%), and the proportion of adolescents who consumed poor dietary diversity was 289 (42.6%). The greater proportion of 594 (90.4%) of the study participants consumed food containing cereals, while only 187 (28% of respondents) reported consuming animal products (table 2).

Wealth index and food security status of households

Regarding household food security measurement, the study participants were asked to report the frequency of worrying about what to eat and the range of remaining hungry day and night in the previous 4 weeks before the survey. Based on the nine HFIAS questions' responses, the frequency of their occurrence over the past 30 days was assessed. As a result, more than half (381 or 56.2%) of the households were food secure, and 297 (43.8%) were food insecure.

Moreover, according to wealth classification, 231 (34.1%) of households had small assets, while 207 (30.5%) and 240 (35.4%) had medium assets and big assets, respectively.

Table 5 Bivariate and multivariable logistic regression analyses for stunting among adolescent students in Lideta subcity, Addis Ababa, 2021

Variables	Stunted		COR (95% CI)	AOR (95% CI)	P value
	Yes	No			
Sex					
Male	31 (4.6%)	333 (49.1%)	1.51 (0.282 to 2.755)	1.316 (0.307 to 5.631)	0.556
Female	18 (2.7%)	296 (43.4%)	1	1	
Family size					
<3	7 (1%)	197 (29.1%)	1	1	
4–5	9 (1.3%)	208 (30.7%)	1.862 (0.844 to 4.106)	1.113 (0.396 to 3.125)	0.839
>5	33 (4.9%)	224 (33%)	2.759 (1.32 to 5.75)	3.77 (1.583 to 8.948)	0.003**
Mothers' occupation					
Housewife	19 (3%)	140 (21.9%)	3.046 (1.33 to 6.929)	1.358 (0.455 to 4.052)	0.583
Daily labourer	6 (0.9%)	73 (11.4%)	1.845 (0.635 to 5.363)	0.979 (0.252 to 4.128)	0.977
Government employee	10 (1.6%)	129 (20.2%)	1.740 (0.688 to 4.398)	2.002 (0.583 to 6.876)	0.27
Non-government employee	4 (0.6%)	46 (7.2%)	1.952 (0.576 to 6.614)	1.257 (0.190 to 8.312)	0.813
Self-employed	9 (1.4%)	202 (31.7%)	1	1	
Household food security status					
Food secure	12 (1.8%)	369 (54.4%)	1	1	
Food insecure	37 (5.5%)	260 (38.3%)	4.376 (2.239 to 8.553)	2.804 (1.378 to 5.706)	0.004**
Individual Dietary Diversity Score					
Good	13 (1.9%)	376 (55.5%)	1	1	
Poor	36 (5.3%)	253 (37.3%)	4.116 (2.14 to 7.914)	2.870 (1.435 to 5.741)	0. 005**
Wealth index					
Poor	31 (4.5%)	200 (29%)	3.978 (1.850 to 8.557)	3.343 (1.510 to 7.403)	0.001**
Middle	9 (1.3%)	198 (29.2%)	1.178 (0.454 to 2.998)	1.190 (0.450 to 3.142)	0.726
Wealthy	9 (1.3%)	231 (34.1%)	1	1	

Reference category: significant at *p<0.05, significant at **p<0.01.
AOR, adjusted OR; COR, crude OR.

Adolescents' eating habits and frequency of eating

The adolescents' eating habits were analysed based on their and their parents' reports on their meal frequency; subsequently, 348 (52.2%) of the adolescents consumed meals three times per day. While 36.1% of the respondents did not eat meat once a week, the vast majority of adolescents (92.2%) ate injera at home, and almost half of the students (45%) did not consume fruits on a weekly basis (table 3).

Prevalence of stunting and thinness among adolescents in public schools

The overall prevalence of stunting and thinness among adolescents was 49 (7.2%; 95% CI 5.3% to 9.3%) and 61 (9%; 95% CI 6.8% to 11.4%), respectively. Thinness was more common among adolescents aged 17–19 years (11%), compared with age groups 14–16 years (8.8%) and 10–13 years (7.8%). Similarly, stunting was more prevalent among adolescents aged 17–19 years old (9.8%), whereas it was 8.2% and 5.1% among those aged 10–13 and 14–16 years old, respectively. Besides, thinness was more than

two times as common and stunting was nearly four times as prevalent among school-aged adolescents from food-insecure households compared with their counterparts, and the proportions of thinness and stunting among adolescents who had poor dietary diversity were 15.9% and 12.5%, respectively. Based on sex category, both thinness and stunting were higher among males (11% and 8.5%, respectively) compared with females (table 4).

Factors associated with stunting among adolescents

The bivariate regression analysis indicated that sex, family size, mothers' occupation, dietary diversity, household food insecurity and wealth index were associated with stunting. On the other hand, in multivariable analysis, family size, individual dietary diversity, household food insecurity and wealth index were statistically and independently associated with stunting,

Adolescents with a family size of more than five had nearly four times higher risk of stunting than those with a family size of less than three (adjusted OR (AOR)=3.764; 95% CI: 1.583 to 8.94). Similarly, participants who were

Table 6 Bivariate and multivariable analyses of thinness among adolescents in public schools of Lideta subcity, Addis Ababa, 2021

| Variables | Thinness | | COR (95% CI) | AOR (95% CI) | P value |
	Yes	No			
Sex					
Male	40 (5.9%)	324 (47.8%)	1.72 (0.993 to 2.989)	1.29 (0.675 to 2.77)	0.439
Female	21 (3.1%)	293 (43.2%)	1	1	
Family size					
<3	10 (1.5 %)	194 (28.6%)	1	1	
4–5	19 (2.8%)	198 (29.2%)	1.86 (0.844 to 4.106)	1.607 (0.707 to 3.64)	0.257
>5	32 (4.7%)	225 (33.2%)	2.76 (1.32 to 5.75)	2.45 (1.140 to 5.29)	0.022*
Mothers' education					
Unable to read and write	12 (1.9%)	73 (11.6%)	3.18 (1.05 to 9.54)	2.593 (1.969 to 8.03)	0.05*
Able to read and write	9 (1.4%)	138 (21.8%)	1.36 (0.473 to 3.923)	2.401 (0.758 to 7.612)	0.137
Primary education	15 (2.4%)	152 (24.1%)	1.51 (0.535 to 4.212)	2.377 (0.765 to 7.380)	0.134
Secondary education	16 (2.5%)	117 (18.5%)	1.13 (0.356 to 3.593)	2.387 (0.342 to 7.706)	0.146
College and above	5 (0.8%)	95 (15%)	1	1	
Household food security status					
Food secure	22 (3.2%)	359 (52.9%)	1	1	
Food insecure	39 (5.8%)	258 (38.1%)	2.47 (1.42 to 4.261)	1.43 (0.767 to 2.66)	0.26
Individual dietary diversity					
Good	15 (2.2%)	374 (55.2%)	1	1	
Poor	46 (6.8%)	243 (35.8%)	4.72 (2.578 to 8.64)	4.812 (2.55 to 9.07)	0. 001**
Wealth index					
Poor	26 (3.8%)	205 (30.2%)	1.66 (0.877 to 3.155)	1.39 (0.668 to 2.925)	0.374
Middle	18 (2.7%)	189 (27.9%)	1.25 (0.626 to 2.492)	1.18 (0.523 to 2.660)	0.691
Wealthy	17 (2.5%)	223 (32.9%)	1	1	

Reference category: significant at *p<0.05, significant at **p<0.01.
AOR, adjusted OR; COR, crude OR.

food insecure at the household level were three times more likely to be stunted (AOR=2.804; 95% CI: 1.378 to 5.706). Furthermore, the chances of stunting were three times higher among participants with poor dietary diversity compared with their counterparts (AOR=2.870; 95% CI: 1.435 to 5.741). The odds of stunting were also higher among adolescent students from poor families (AOR=3.343; 95% CI: 1.51 to 7.41) (table 5).

Factors associated with thinness among adolescent students

A bivariate analysis revealed that sex, family size, mothers' education, fathers' career, individual dietary diversity, household food security and wealth index were all related to thinness. Multivariable analysis, however, showed that family size, mothers' education and individual dietary diversity were statistically and independently related to thinness after controlling for confounding variables. Accordingly, adolescents from families with a family size of more than five were nearly 2.4 times more likely than those with a family size of less than three to acquire thinness (AOR=2.458, 95% CI: 1.140 to 5.296).

Similarly, the odds of being thin were three times higher among participants whose mothers were not able to read and write compared with participants whose mothers had a college diploma and above (AOR=2.59; 95% CI: 1.969 to 8.003). Individuals with insufficient dietary diversity had nearly fivefold higher risk of being thin than their peers (AOR=4.812; 95% CI: 2.552 to 9.072) (table 6).

DISCUSSION

The current study's findings revealed that the prevalence of stunting and thinness was higher in male and older adolescents than in younger ones. The results were consistent with those of another study done in southern and central Ethiopia.[32 33] A possible explanation behind this might be due to the fact that those young adolescents participate in the school lunch programme.

Overall, 7.2% of adolescents in public schools in Lideta, a subcity of Addis Ababa, were stunted. When compared with a study report from Brazil (6%)[34] and

Kenya (6.5%),[35] this result was higher. Differences in socioeconomic, cultural and seasonal factors could explain the difference. However, this result was lower than those of research conducted in Damot Sore district, southern Ethiopia (29.6%)[32] and in Adama city, central Ethiopia (21.3%).[33] This disparity could be explained by a difference in income between the two research areas and study periods. Adolescents in Addis Ababa were more likely to have access to food and nutrition information, and belonged to educated households than those in Ambo and Adama city. Moreover, there has been an SFP in Addis Ababa since 2019.

School-aged adolescents who lived in households with five members or more were nearly four times more likely to be stunted than school-aged adolescents who lived in households with three members. A study conducted in Dale, southern Ethiopia; Axum town, northern Ethiopia; and Indonesia backed up the findings.[35–37] This could be due to the large number of family members sharing the limited food, resulting in insufficient food consumption and stunting. Furthermore, when family size increased, per capita human inputs declined, which could be explained by a larger dependency ratio, resulting in poorer nutritional consumption among adolescent students.

Adolescents with poor dietary diversity were three times more likely to be stunted than their counterparts. This finding was consistent with a report from Dangila, western Ethiopia; Rabat, Morocco; and India.[22 38 39] This could be explained by the fact that, in a phase of rapid growth and development, poor dietary diversity and irregular food intake are less likely to meet adolescents' nutritional requirements. As a result, failure to provide adequate food for daily body demand would result in stunting.

Household food insecurity was found to be significantly linked to stunting, with adolescents from food-insecure families roughly three times more likely to be stunted than those from food-secure families. This finding was supported by data from Jimma, southwest Ethiopia, the Somali region, eastern Ethiopia and a meta-analysis from developing regions.[21 40 41] The possible explanation for this could be high market and food inflation, which may have negatively impacted the food security situation of urban households, in addition to seasonal variations within and across countries. As a result, adolescents may have reduced food intake, consumed poor-quality diets or disrupted eating patterns, which can ultimately lead to stunting.

Adolescents from poor families were three times more stunted than those from wealthy families. This conclusion was backed up by research conducted in the Gurage zone, Ethiopia[42]; Axum, northern Ethiopia[36]; and Bihar, India.[25] This could imply that the nutritional status of teenagers is solely determined by the socioeconomic position of the households in which they live. This further results in insufficient dietary quality and quantity due to the inability to purchase a variety of foods and eating preferences. Furthermore, adolescents from low-income households may have less access

to and utilisation of healthcare than those from wealthy families.

Thinness was found to be prevalent in 9% of the study populations. This finding was consistent with a study conducted in Debark, northern Ethiopia, which reported 10.3%,[43] and Yaoundé, Cameroon, which reported 9.5%.[44] However, it was lower than studies in Mekelle city, northern Ethiopia, at 26.1%[14]; Western Kenya, at 15.6%[45]; and India, at 20%.[46] This gap could be attributable to the implementation of nutrition intervention programmes in Addis Ababa public schools by state and non-governmental organisations. Furthermore, cultural differences and socioeconomic disparities may play a role.

The odds of being skinny were 2.5 times greater among participants whose mothers could not read or write compared with participants whose mothers had a college diploma or higher educational standing. This result was similar to those found in Adwa, Ethiopia[47]; Assam, India[42]; and Adama, Ethiopia.[34] This could be due to the mothers' low level of education, a lack of nutrition knowledge, or the fact that they are not formally educated and cannot understand different promotions. As a result, their decision-making ability and contribution to the total family income will be limited. It could also have an impact on the type of food that is made and supplied.

Adolescents from households with more than five individuals were 2.4 times thinner than those from households with fewer than three members. Axum town in northern Ethiopia[36] and Riyadh, Saudi Arabia[48] have both reported similar occurrences. This could be due to the numerous household members sharing the available food and increased competition for food, which could impair both the quality and amount of food served at home, resulting in insufficient food consumption and thinness.

When it comes to dietary diversity, adolescents with insufficient nutritional diversity were 4.8 times thinner than those with substantial dietary diversity. This result was similar to those reported in Karnataka, India[35] and Axum, Ethiopia.[36] This could be attributed to a lack of nutritional diversification and irregular meals.

Limitation

The current study is cross-sectional in design, which does not establish a causal relationship between the outcome variable and independent factors. In addition, we used a 24-hour recall to account for the number of food categories ingested that might be affected by recall and social desirability bias.

CONCLUSION AND RECOMMENDATION

Adolescent stunting and thinness were common. Thinness was connected to parental education, family size and individual dietary diversity. Stunting was also linked to household income, family size, food insecurity and dietary diversity. Therefore, to decrease adolescent undernutrition, the administration of Addis Ababa city should prioritise minimising food insecurity while boosting

productivity to enhance adolescent nutritional diversity. Moreover, nutrition education should be strengthened by healthcare providers working at public schools as well as health extension workers.

ORCID iDs
Genanew Kassie Getahun http://orcid.org/0000-0002-0796-5433
Esmael Ali Muhammad http://orcid.org/0000-0003-1976-4388
Tewoderos Shitemaw http://orcid.org/0000-0002-5566-204X

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