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Under nutrition and its associated factors among adolescent girls in rural community of Aseko district, Eastern Arsi Zone, Oromia region, Eastern Ethiopia, 2017

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Abstract
Background: Adolescence is a particularly unique period in life because it is a time of intense physical, psychosocial, and cognitive development.
Objective: To assess the magnitude of under nutrition and associated factors among adolescent girls (10-19years old) in rural community of Aseko district, Arsi zone, Ethiopia.
Methods: A community based cross-sectional study was conducted on 683 adolescent girls. Body Mass Index for age and height for age was used to assess under nutrition of adolescent girls by using the new 2007 WHO Growth Reference. A simple random sampling technique was used to select study participants.
Result: The magnitude of stunting and thinness in this study were 20.2% and 14.8% respectively. 1-2 times meat consumption per week (AOR=2.52, 95%CI: 1.04-6.11) and feeding of meal less than 3 times per day (AOR=1.67, 95%CI: 1.107-2.61) were factors significantly affecting low height for age and while adolescent pre-menstruation status (AOR=1.72, 95%CI: 1.03-2.88) and monotonies diet (AOR=2.35, 95%CI: 1.08-5.10) were factors associated with low body mass index for age of adolescent girls respectively.
Conclusion: Under nutrition was prevalent among adolescent girls in Aseko district.

Keywords: Under nutrition, Adolescent, Aseko, Arsi

Introduction
According to World Health Organization (1986) adolescent is defined as people whose ages are in between 10 and 19 years old (WHO, 2002). There are 1.2 billion adolescents (aged 10–19 years) in the world which makes 18% of the world population and it is estimated to reach 1.3 billion by 2050 and while 90% live in low- and middle-income countries, where they comprise 19% of the population (UNICEF, 2012) [22]. In 2010, 23% of sub-Sahara Africa populations were adolescents and it is expected to have more adolescents than any other region by 2050. According to UNICEF report in 2012, 25% of the total populations in Ethiopia were represented by adolescents (UNICEF, 2012) [22].

Adolescent is a particularly unique period in life because it is a time of intense physical, psychosocial, and cognitive development and it is the age at which growth is faster than at any other time in the individual's life next to infancy. They are increased nutritional requirements during adolescent than any age group in the life cycle which is related to the fact that adolescents gain up to 50% of their adult weight, more than 20% of their adult height, and 50% of their adult skeletal mass (WHO, 2002).

Biological, psychosocial and cognitive changes that begin during puberty and continue throughout adolescence directly affect nutritional status and nutrient needs. Adolescents experience dramatic physical growth and development during puberty, which in turn appreciably increases their requirements for energy, protein, and many vitamins and minerals. Adolescents also experience significant changes in their ability to assess and comprehend complex situations and information and in their desire to become independent, unique individuals. The increased need for energy and nutrients among adolescents, combined with increasing financial independence, increasing need for autonomy when making food choices, and immature cognitive abilities, places adolescents at nutritional risk (Story and Stang, 2005) [19].

Inadequate nutrition in adolescence can potentially retard growth and sexual maturation, although these are likely consequences of chronic malnutrition in early infancy and childhood and one major reason for focusing on adolescents is that this period of a child's life is a unique opportunity to break a range of vicious cycles of structural problems that are passed from one generation to the next, such as poverty, gender discrimination, violence, poor health and nutrition (WHO, 2005). Adolescent girls that bear children are more likely than older mothers to die during childbirth, or to be left nutritionally depleted (CDPH, 2012) [2].

World health organization now a day recommend the new WHO Growth Refernce (2007) to measure undernutriton among adolescent by using height -for -age and body mass index –for-age indictaors. BMI-for-age is the recommended indicator for assessing thinness, overweight and obesity and height- for- age for stuntting in children 10-19 years. Therefore undernutrition among adolescent is defined as stunting those which their height for age is <-2SD and thinness those which their body mass index for age is <-2SD according to the 2007 WHO new growth reference (WHO, 2009) [26].

The main nutritional problems which affect adolescents are undernutrition in terms of stunting, thinness, catch-up growth, and intrauterine growth retardation in pregnant adolescent girls; iron deficiency anemia; iodine, vitamin A; and calcium deficiencies; and other specific nutrient deficiencies (WHO, 2002). Therefore poor nutrition during any stages of adolescent can have lasting consequences on cognitive development, resulting in decreased learning ability, poor concentration, and impaired school performance (CDPH, 2012) [2]; and can cause the nutritional status of children born to mothers who were malnourished during adolescence (WHO, 2006) [25].

Globally, undernutriton among adolescent girls are highly prevalent in different parts of the world. For example, according to the study which was done by World Health Organization (WHO) on South East Asia region (both sex) in India, Bangladesh, Nepal and Myanmar showed around 32%, 48%, 47% and 39% of adolescents were suffered from stunting respectively, and 53%, 67%, 36%, and 32% adolescents were affected by thinness respectively (WHO, 2006) [25]. These are also true in different parts of the world as different scholars revealed. For instance, the studies which were conducted in some parts of India among adolescent girls revealed the higher prevalence of undernutrition which ranges from 32% to73.5 % (Shivaramakrishna1 *et al., 2* 011; Maiti *et.al*., 2011; Mondal *et al.,* 2010) [9, 12] and another study in Bangladesh among adolescents to determine prevalence of thinness and stunting also showed the higher prevalence of under nutrition; and there were also high prevalence of stunting among adolescent girls (50.3%) than boys (43.1%) (Azizu and Karim, 2014) [14]. In china around 21.8 and 40.6 million children and adolescents were affected with thinness and stunting in 2002 respectively and while 5.8 million were co- affected by stunting and thinness (LI et *al.,* 2009) [27].

Undernutrition among adolescent girl is also a common nutritional problem in Africa as some study shows by different researchers. For instance, the study which was conducted in South East Nigeria reported over 20% of the adolescents were affected by thinness and 67.3% boys and 57.8% girls, were also affected by stunting (Ogechi *et al.,* 2007) [13]. The other study in western Kenya also showed that 12.1 % and 15.6%, of school adolescent were stunting and thin respectively (Leenstra *et al.,* 2005) [8].

Undernutrition among adolescent girl in Ethiopia is also a public health problem as some studies done in different parts of the country indicated. The Ethiopia nutrition baseline report reported in 2010 that, 23 % of adolescent girls were stunted, with girls 13 to 14 years old and rural resident were more likely to be stunted; and at the same time 14% of adolescent girls were thin (EHNRI, 2009/10) [5]. The community based studies which were conducted in Tigray and Amhara region showed both thinness and stunting were highly prevalent among adolescent girls of rural Ethiopia which were 26.5% stunted and while 58.3% thin; and 13.6 % thin and while 31.5 % stunted respectively (Afework *et al.,* 2009; Molla *et al.,* 2015) [1, 11].

Adolescents are the future generation of any country and their nutritional needs are critical for the well-being of society; however in most developing countries, nutrition initiatives have been focusing on children and women, thus neglecting adolescents (WHO, 2006) [25]. Up to recently, little was known about nutritional status of adolescents, particularly in low- and middle-income countries (WHO, 2005) [24]. This is also true for Ethiopia- ; Even though, some studies which were conducted in different parts of Ethiopia indicates the existence of high prevalence of under nutrition among adolescent girl, it doesn't get strong attention same as under- five children and maternal nutrition. There is also limited information in Ethiopia at national level and in our study area in particular concerning under nutrition and associated factors among rural adolescent girls. Therefore, this study was aim to fill this information gap by assessing the magnitude of undernutrition and associated factors among adolescent girls in rural community of Aseko district, Arsi zone, Oromia, Ethiopia.

Methodology

Study design-A community based cross sectional study design was employed

Source population -all adolescent girls which were found in rural area of Aseko district.

Study population- randomly selected adolescent girls (10-19 years) from *kebeles*.

Inclusion criteria -Adolescent girls who lived in the study area for at least six months, none lactating and self-reported none pregnant, married and non married adolescent girls those between 10-19 years age group were included in the study.

Exclusion criteria -Adolescent girls, who were critically ill, physically deformed or disabled.

Sample size determination and sampling techniques

Sample size determination

The required sample size for the first objective of this study is calculated by using single population proportion formula through assumption of 95% confidence interval (CI), 5% margin of error, 1.5 design effect, and prevalence of thinness and stunting among adolescent girls were 21.5% and 15% respectively from the community based study in Babile district (Kedir *et al.,*2016) [6].

$$n=\frac{z^2pq}{d^2}$$ where, p=prevalence of thinness (21.5%) and stunting (15%) from the research done in Babile district. z=1.96 with 95% of confidence interval, q = 1-p, d = margin of error tolerated (0.05) n = the required sample size.

Table 1: Single population proportion based sample size determination for a study on under nutrition and associated factors among adolescent girls in rural area of Aseko district, Eastern Arsi zone, Ethiopia, 2017.

Prevalence	Margin of error	CI	Sample size
Thinness	5%	95%	264
Stunting	5%	95%	196

The largest sample size from the table and by considering the non-response rate of 10%, the final sample size becomes 290.

To determine the required sample size for the second specific objective of this study, by considering various factors which significantly associated with the outcome variables with confidence level of 95%, margin of error of 5 % and power of 80%, and by using Open Epi menu online software program the sample size was calculated for those selected variables and the maximum sample size was taken for final required sample size and by considering 10% non-response rate.

Table 2: Double population proportion based sample size determination for a study on under nutrition and associated factors among adolescent girls in rural area of Aseko district, Eastern Arsi zone, Ethiopia.

Second specific objective	Factors considered	Proportion value (percent of exposed with outcome and percent of unexposed with outcome)	Sample size
The most associated factors for under nutrition among adolescent girl.	Age of adolescent girl (Kedir *et al.*, 2016) [6].	Stunting among 10-14 years old of adolescent girl=19.8% And while among 17-19 years =34.1%	326
	Family size (Tsgehana *et.al* 2016) [21]	Thinness among adolescent girl Who have family size > 5=31.2% and for family ≤ 5 =13.2%	188
	Family size (Tsgehana *et.al*., 2016) [21]	Stunting among adolescent girl of family size >5=17.4% and among family size of ≤5 =7.8%	414

At the end, the required sample size is decided by taking the maximum sample size from the first (290) and second (455) objective after 10% of non-response rate considered. Finally by considering the design effect of 1.5 on the largest sample size the required sample of this study is 683.

Sampling procedure

The first five kebeles were selected randomly by lottery method out of 17 rural kebels in Aseko district and then the households which contain minimum of one adolescent girl was identified from family folder report of each selected kebele which obtained from health extension workers. Then the study participants were allocated to each selected kebele by using proportion to total households which contain minimum of one adolescent girl. By Considering the list of the households which contain minimum of one adolescent girl as sampling frame and taking the adolescent in the households as sampling unit, simple random sampling was employed in order to select the households. If there are more than one adolescents girls in the same households, one of them was selected randomly by lottery method.

Data collection methods

Data were collected by using pre designed structured questionnaires which adapted from different literature reviews (Afework *et al*., 2009, Tolessa *et al*., 2015, Roba *et al*., 2016, Huruy *et al*., 2015,Tsgehana *et al*., 2016 and Molla *et al*., 2015) [1, 11, 21, 20, 15, 4] and anthropometric measurements of adolescent girls who meets the inclusion criteria of the study. The questionnaires were containing parents and adolescent socio-demographic factors, adolescent feeding behaviors, and household and environmental factors. The adolescent dietary intake pattern was measured by a qualitative recall of all foods consumed by each adolescent girl during the previous 24 hours. Thus, certain food groups were aggregated to calculate Individual dietary diversity score (IDDS) and the mean DDS was used to classify adolescent food intake as adequate or not (Kennedy *et al.*, 2013) [7]. Care was taken to exclude atypical days of food consumption (special ceremonies and celebration days). Food frequency pattern was collected from adolescent girls by asking their most commonly consumed food groups patterns in last one week prior to the actual data collection time.

The household food insecurity level was measured with Household Food Insecurity Access Scale (HFIAS), a structured, standardized and validated tool that developed mainly by FANTA version 3, to classify the households as food secured or not (Coates *et al*., 2007) [3]. The scale has been shown to be a valid tool in measuring household food insecurity among both rural and urban areas of Ethiopia with cronbach's alpha values of 0.76 for round 1 and 0.73 for round 2 (Seifu *et al*., 2015) [17].

The data was collected by 10 data collectors who completed at least grade ten including health extension workers and the supervision was conducted by 2 health officer after providing 2 days training on ways of data collection process. The interviewees of this study were adolescent girls but the household food insecurity questions were asked the household member who was responsible for the preparation of food. To get the study participants data collectors were move house to house and for those who were busy or not available during data collection period due to school or any other personal factors, a revisit was arranged at a minimum of three times. The data collection was conducted at the whole day including the weekend. Training was given for data collectors by Afan Oromo on how to take anthropometric measurements, ask and fill the questions, and how to approach the respondents. The selected participants were informed by the data collector as she is selected to participate in the study. After the selected participant is interested, then the consent was obtained and the data was collected. Anthropometric measurements: trained data collectors were record height and weight by using a portable wooden height-measuring board with a sliding head bar following standard anthropometric techniques and portable electronic digital scales respectively. For height measurement, subjects were asked to stand erect with their shoulders level, hands at their sides, thighs and heels comfortably together, the buttocks, scapulae, and head are positioned in contact with the vertical backboard with a sliding head bar. Then height was measured to the nearest 0.1 cm. For weight measurement, adolescent girls were asked to remove their shoes, wear light cloths and then, trained data collectors were weigh the subjects on a calibrated portable digital scale and were record the value to the nearest 0.1 kilogram. Each measurement was standardized and calibrated by carefully handling and periodical calibration by placing standard calibration weights on the scale to ascertain accuracy. Finally

anthropometric measurements were changed to height for- age and BMI-for-age z scores to determine the nutritional status of adolescent girls by using WHO Anthros plus version 1.0.4 software.

Data quality control

To ensure the quality of the data, structured and pretested questionnaire were used. Pretest of the questionnaire was done before actual data collection period among 5% of the study sample at Marti district which is nearest to the study area. This was help for further clarification of instruments and to help data collectors to familiarize with the instrument and to estimate the time needed. The structured questionnaire was first be prepared in English and then translated into the local language of the respondents (Afan Oromo) and again translated back to English to increase the questionnaire consistency. Two days intensive training was provided about the instruments, ways of data collection, how to measure anthropometric data, ethical issues and aims of the study for data collectors and supervisors by principal investigator (PI).

To minimize the intra and inter- observer's variability of the data collector's relative technical errors of measurement were calculated during training among 10 adolescent girls. The accepted relative technical measurement errors for intra-observers were less than 1.5% and while for inter- observers were less than 2%. To increase the accuracy of each data collector anthropometric measurement; their measurement results were compared and standardized with their trainer during training and pretesting. Data collectors were measure twice and take the average of the measurements for every height and weight of an adolescent girl. Proper function of digital weight scales was checked every time before weight measurement begins. The data collectors should assure the reading scale is exactly at zero. Supervision was done by selected two health officers and they were check completeness, accuracy, and consistency of the collected data through the entire of the data collection period. The all over supervision was carried out by the principal investigator. For the comparison of two data cells and some difference double data entry was used.

Data processing and analysis

Data was checked for completeness before it is entered to a computer. Then it was coded and double entered to EPI-DATA 3.1 software. Age, height and weight of adolescents were entered to WHO Anthros plus version 1.0.4 software to convert nutritional data into Z-score of the indices. The entered data to EPI-DATA 3.1 software was transformed to SPSS version 20 for further analysis. Individual dietary diversity score (IDDS) were calculated and the mean DDS was used to classify adolescent food intake as adequate or not (Kennedy *et al.*, 2013) [7]. Household Food Insecurity Access Scale (HFIAS) categories were calculated and the households classified as food secured or not (Coates *et al*., 2007) [3]. After stunting and thinness determined by WHO antros plus; it was transformed to spss and then data analysis was done separately for each outcome variable by using bivariate logistic Regresion to determine the association between predictors and outcome variables. It was checked by crude odds ratio and 95% confidence level. Then those which shows significant association (p value≤0.25) obtained by bivariate analysis were candidate variables for multivariable analysis. Lastly Model fitness was checked by using Hosmer-lemshow test (>0.05) and to check multicollinearity standard error (<2) was used. With the multivariate analysis adjusted odd ratio with 95%confidence level was used to determine associated factors with thinness and stunting. In multivariate analysis statistical significant variables are those which had p-value <0.05.

Ethical consideration

The study was reviewed and approved by Haramaya University College of Health and Medical Sciences. The ethical clearance was obtained from Institutional Health Research Ethical Review Committee (IHRERC) and Official letter was sent to Aseko district health office and the data collection was begin after permission and cooperation obtained from all selected kebeles of study area. Informed, voluntary, written and signed consent from the adolescents' parents were sought for adolescents <18 years old and adolescent consent was taken for those ≥18 years old. Aims of study, duration, any possible risk of the study was explained for study participants by using local language.

Results

In this study data were collected from 642 adolescent girls aged 10-19 years and from household members who is responsible for food preparation with the response rate of 94%. Thus the collected data were used to determine the magnitude of under nutrition and associated factors in the study area.

Parents socio-demographic factors

Among study participants mother 65.9% were Muslim, 33.5% were orthodox, 0.5% were protestant and 0.2% were other (catholic) by their religion. About 63.9% of study participants contain the household sizes of greater than or equal to 5. Around 46% and 38% of adolescent girl's mothers and fathers were unable to read and write whereas the least percent have joined college or university, 1.6% for mother and while 3% for father by their educational status. Regarding to the occupation of study participants father the majority were farmer (92.7%) followed by merchant (5.9%) and employer (1.4%), on the other hand more than half of mother occupation were housewife (68.2%) followed by farmer (23.5%), merchant (5%) and employer (3.3%) respectively. Around 81.3% of households were headed by male and whereas 18.7% were by female (Table 3).

Adolescent girls related factors

Among 642 adolescent girls participated in the study, the around the half were in the age group between 10-14 years old (48.4%) and the majority (84.4%) were single by their marital status. Around 40.8% of adolescent girls were primary (1-8) by their educational status. About 78.3% of adolescent girls were started menses and 74.3% were seen their menarche at the age of less than or equal to 14 years old. All most half, (52.5%) of adolescents have no any access to health and nutrition information (Table 4).

Dietary diversity score by adolescent girls

The minimum and maximum dietary diversity score of this study were 1 and 9 respectively with mean (±SD) score of 4.82 ±1.76. Nearly, 75.5% of adolescent girls had dietary diversity score of greater than or equal to four. The most commonly consumed food group by adolescent girls in the study area was starchy staple (97.2%) and while the least consumed food group was organ meat (12.9%) (Table-5).

Food frequency pattern of adolescent girls

About 57% of the adolescent girls were frequently consumed foods prepared of cereals and grain more than three times per week while 40.2% of them were consume one to two times per

week. Meat and fish are the least frequently consumed food items as only 9% and 1.1% adolescents reported they have consumed those more than three times per week respectively (Table-6).

Household food insecurity access scale condition (HFIAS)

This data were collected from any of household member of the study participants who was responsible for the preparation of food in the household. More than half, (61.1%) of adolescent girl's family were from food secured and while around 38.9% were from food in secure households (17.6% were from moderately food insecure, 13.9% mildly food insecure and while 7.5% were from severely food insecure households.

Adolescent feeding practice and Environmental factors

Around 48.4% of study participants staple food is prepared from sorghum followed by maize 28.5%, *teff* (20.2%) and barley (3.9%). Regarding to adolescent girls meal pattern around 63.2% were feed sometimes different, 15.9% were feed monotonies and 20.9% were always different meal patterns respectively. Regarding to the number of meal per day 44.1% of study participant were feed less than 3 time per day and while 55.9% were feed greater than or equal to 3 times per day. Nearly half, (46.1%) of the study participants source of drinking water were unprotected well or spring which followed by pipe water 35% and protected well or spring water were 18.8% respectively (Table-7).

Prevalence of under nutrition

Under nutrition among adolescents were indicated by stunting and thinness. The prevalence of stunting among adolescent girls in this study was 20.2%. The age specific prevalence of stunting was 19.6% for 10-14yrs old, 20.8% for 15-17yrs old and while 20.9% was for 18-19yrs old adolescent girls of the study area. The prevalence of thinness among adolescent girls in this study was 14.8%. The age specific prevalence of thinness among study participants was 16.1% for 10-14yrs old, 12.2% for 15-17yrs old and while 16.4% was for 18-19yrs old adolescent girls of the study area.

Factors associated with stunting

In this study, factors that are associated with stunting in bivariate analysis were family size, dietary diversity, access to health and nutrition information, number of meal per day, meat frequency. In multivariable analysis; all variables that showed an association in bivariarite analysis and the variables that had p-value of less than 0.25 in bivaraite analysis like cereal frequency, vegetable frequency, daily based diversified meal patterns and food insecurity were included. In multivariable logistic regression model significant association between stunting and number of meal per day was observed. Adolescent girls who feed less than 3 times meal per day were 1.67 times more likely to be stunted as compared to adolescent girls who feed greater than or equal to 3 times per day (AOR=1.67.95%CI:1.07-2.61, *P*<0.05). Similarly strong association has seen between stunting and meat frequency. Adolescent girls who feed meat 1-2 times per week were 2.52 time more likely to be stunted as compared to those who feed greater than or equal to 3 times per week (AOR=2.52.95% CI:1.04-6.11, *P*<0.05) (Table 8).

Factors associated with thinness

Variables associated with thinness in bivariate analysis were adolescent menstruation status and daily based diversified meal patterns. In the second analysis, all variables that showed an association in first step of analysis and the variables which showed the p-value of less than 0.25 like family size, mother occupation, sex of household head, vegetables frequency, legumes frequency and availability of home garden were included in multivariable analysis.

In the final model it was observed that, Premenstrual adolescent girls were 1.72 times more likely to be thin than postmenstrual adolescents (AOR=1.72, 95%CI: 1.03-2.88, p value <0.05). Similarly diversified meal patterns per day were significantly associated with thinness of adolescent girls. Adolescent girls who had monotonies diet patterns were 2.35 times more likely to be thin as compared to adolescent girls who had always diversified food patterns per day(AOR=2.35,95%CI: (1.08-5.10,p value<0.05) (Table 9).

Table 3: Parents socio-demographic characteristics of adolescent girls Aseko, district, East Arsi Zone, Ethiopia 2017(N=642).

Variables	Frequency	Percent (%)
Mother religion		
Orthodox	215	33.5
Muslim	423	65.9
Protestant	3	0.5
Others	1	0.2
Father religion		
Orthodox	211	32.9
Muslim	427	66.5
Protestant	3	0.5
Others	1	0.2
Family size		
<5	232	36.1
≥5	410	63.9
Educational status of mother		
Not read and write	295	46
Read and write	124	19.3
Primary	166	25.9
Secondary	47	7.3
College or university	10	1.6
Educational status of father		
Not read and write	244	38
Read and write	107	16.7
Primary	135	21
Secondary	137	21.3
College or university	19	3
Mother occupation		
Farmer	151	23.5
Housewife	438	68.2
Merchant	32	5
Employer	21	3.3
Father occupation		
Farmer	595	92.7
Merchant	38	5.9
Employer	9	1.4
Household head		
Male	522	81.3
Female	120	18.7

Table 4: Socio-demographic characteristics of adolescent girls in Aseko, district, East Arsi, Ethiopia, 2017(N=642).

Variables	Frequency	Percent (%)
Age of adolescent girls		
10-14	311	48.4
15-17	221	34.4
18-19	110	17.1
Adolescent ethnic group		
Oromo	526	81.9
Amhara	115	17.9
Gurage	1	0.2
Adolescent religion		
Orthodox	203	31.6
Muslim	424	67.6
Protestant	4	0.6
Others	1	0.2
Adolescent marital status		
Single	542	84.4
Married	93	14.5
Divorced	4	0.6
Separated	3	0.2
Educational status of adolescent		
Not read and write	153	23.8
Read and write	88	13.7
Primary	262	40.8
Secondary	136	21.2
College or university	3	0.5
Adolescent menstruation status		
Started	503	78.3
Not started	139	21.7
Age at menarche		
≤14	477	74.3
>14	26	4.0
Job		
Yes	87	13.6
No	555	86.4
Access to health and nutrition information		
Yes	305	47.5
No	337	52.5

Table 5: Proportion of adolescent girls aged 10-19 years who consumed different food groups in last 24 hrs preceding the date of survey in Aseko district, East Arsi, Ethiopia, 2017 (N=642).

Food groups	Frequency	Percent (%)
Starchy staples	624	97.2
Dark green leafy vegetables	232	36.1
Other vitamin A rich fruits and vegetables	451	70.2
Others fruits and vegetable	347	54
Organ meat	83	12.9
Flesh meat and fish	177	27.4
Any eggs	328	51.1
Legumes, nuts and seed	574	89.4
Milk and milk product	276	43
Adolescent girls dietary diversity score Mean ±SD 4.82±1.76		

Table 6: Food frequency patterns by adolescent girls aged 10-19yrs in the last one week prior to survey in Aseko district, East Arsi Zone, Ethiopia 2017(N=642).

Food groups	Never	1-2 times per week	≥ 3 times per week
	No (%)	No (%)	No (%)
Cereals	18(2.8)	258(40.2)	366(57)
Vegetables	128(19.9)	348(54.2)	166(25.9)
Tubers and roots	150(23.4)	362(56.4)	130(20.2)
Fruits	159(24.8)	380(59.2)	103(16)
Meats	273(42.5)	311(48.4)	58(9)
Any eggs	172(26.8)	388(60.4)	82(12.8)
Fish	546(83)	89(13.9)	7(1.1)
Beans, lentils, peas	39(6.1)	358(55.8)	245(38.2)
Milk and milk product	138(21.5)	389(60.6)	115(17.9)
Beverage like tea and coffee	159(24.8)	290(45.2)	193(30.1)
Food cooked by adding of oil and fats	84(13.1)	321(50)	237(36.9)

Table 7: Environmental and adolescent factors among adolescent girls aged 10-19yrs in Aseko distrit, East Arsi Zone, Ethiopia, 2017 (N=642).

Variables	Frequency (N)	Percent (%)
Staples food		
Sorghum	304	47.4
Maize	183	28.5
Teff	130	20.2
Barely	25	3.9
Patterns of diversified meal		
Monotonies	102	15.9
Sometimes different	406	63.2
Always different	134	20.9
Number of meal per days		
Less than 3	283	44.1
Greater or equal to 3	359	55.9
Gardening		
Yes	183	28.5
No	459	71.5
Source of drinking water		
Pipe	225	35
Protected well or spring	121	18.8
Unprotected well or spring	296	46.1
Toilet		
Yes	422	65.7
No	220	34.3
Others defecation area		
Open	183	28.5
Public	38	5.9
Hand washing after toilet		
Yes	454	70.7
No	188	29.3

Table 8: Both bivariate and multivariable logistic regression analysis result of factors affecting stunting of adolescent girls aged 10-19 yrs in Aseko district, East Arsi zone, Ethiopia, 2017(N=642).

Variables	Stunted (%)	Not stunted (%)	Crude OR (95%CI)	Adjusted OR (95%CI)
Family size				
<5	57(24.6%)	175(75.4%)	1	1
≥5	73(17.8%)	337(82.2%)	0.67(0.45-0.98)	0.670(0.44-1.02)
Access to health and nutrition information				
Yes	72(23.6%)	233(76.4%)	1	1
No	58(17.2%)	279(82.8%)	0.67(0.46-0.99)	0.70(0.46-1.06)
Meat frequency				
Never	48(17.6%)	225(82.4%)	1.55(0.66-3.63)	2.06(0.80-5.32)
1-2	75(24.1%)	236(75.9%)	2.32(1.01-5.32)	2.52(1.04-6.11)*
≥3	7(12.1%)	51(87.9%)	1	1
Number of meal per day				
<3	87(24.2%)	272(75.8%)	1.79(1.19-2.68)	1.67(1.07-2.61)*
≥3	43(15.2%)	240(84.8%)	1	1
DDS				
Low	24(15.3%)	133(84.7%)	0.56(0.33-0.96)	0.82(0.52-1.30)
Medium	50(19.7%)	204(80.3%)	0.77 (0.50-1.20)	0.85 (0.46-1.60)
High	56(24.2%)	175(75.8%)	1	1

Key: The asterisk * shows p value less than 0.05, [1] Shows Hosmer and Lemshow of p-value 0.285 OR=odd ratio.

Table 9: Bivariate and Multivariable logistic regression[1]analysis for factors predicting the likelihood of adolescent girls to be thin in Aseko district, East Arsi zone, Ethiopia, 2017(N=642).

Variables	Thin (%)	Not thin (%)	Crud OR(95%CI)	Adjusted OR(95%CI)
Family size				
<5	29(12.5%)	203(87.5%)	1	1
≥5	66(16.1%)	344(83.9%)	1.34(0.84-2.15)	1.51(0.92-2.49)
Mother occupation				
Farmer	24(15.9%)	127(84.1%)	3.78(0.48-29.51)	2.76(0.34-22.29)
Housewife	63(14.4%)	375(85.6%)	3.36(0.44-25.48)	2.67(0.34-20.87)
Merchant	7(21.9)	25(78.1%)	5.60(0.64-49.35)	4.27(0.47-38.74)
Employer	1(4.8%)	20(95.2%)	1	1
Household head				
Male	73(14%)	449(86%)	0.72(0.43-1.22)	0.81(0.47-1.39)
Female	22(18.3%)	98(81.7%)	1	1
Adolescent menstruation status				
Started	67(13.3%)	436(86.7%)	1	1
Not started	28(20.1%)	111(79.9%)	1.64(1.01-2.67)	1.72(1.03-2.88)*
Diversified meal Patterns				
Monotonies	21(20.6%)	81(79.4%)	2.06(1.01-4.23)	2.35 (1.08-5.10)*
Sometimes different	59(14.5%)	347(85.5%)	1.35(0.74-2.47)	1.46(0.77-2.75)
Always different	15(11.2%)	119(88.8%)	1	1
Vegetables frequency				
Never	19(14.8%)	109(85.2%)	1.35(0.68-2.67)	1.40 (0.68-2.89)
1-2	57(16.4%)	291(83.6%)	1.52(0.87-2.64)	1.47 (0.83-2.61)
≥3	19(11.5%)	147(88.5%)	1	1
Legumes frequency				
Never	5(12.8%)	34(87.2%)	1.02(0.37-2.79)	0.91(0.32-2.58)
1-2	59(16.5%)	299(83.5%)	1.36(0.87-2.64)	1.25 (0.77-2.03)
≥3	31(12.7%)	214(87.3%)	1	1
Garden				
Yes	33(18%)	150(82%)	1	1
No	62(13.5%)	397(86.5%)	0.71(0.45-1.13)	0.66 (0.41-1.07)

Key: The asterisk * shows p value less than 0.05, [1] Shows Hosmer and Lemshow of p-value 0.285, OR=odd ratio.

Discussion

The main nutritional problems which affect adolescents are under nutrition in terms of stunting, thinness and other specific nutrient deficiencies. Therefore Poor nutrition during any stages of adolescent can resulting in decreased learning ability, poor concentration, impaired school performance, retard growth and sexual maturation, and also can cause the nutritional status of children born to mothers who were malnourished during adolescence. This study was conducted to determine the magnitudes and associated factors of under nutrition in adolescent girls. The prevalence of stunting and thinness of this study were 20.2% and 14.8% respectively. In this study factors like frequency of meat consumption and number of meal per day were factors associated with stunting and while diversified meal patterns and menstruation status were significantly associated factors with thinness of adolescent girls.

The prevalence of stunting in this study was comparable with study conducted in Wukro town, Northern Ethiopia 21.2% (Yohannes *et al.,* 2015) [28] and national nutrition survey report of Ethiopia 23% (EHNRI, 2009/10) [5] but less than the finding in Amhara region 31.5 % (Molla *et al*., 2015) [11]. The possible reason for this prevalence difference could be due to malnutrition during childhood. The other possible explanation for this prevalence variation could be socio-demographic difference like early marriage and pregnancy.

However; the prevalence of stunting in this study was greater than studies conducted in Babile district, Oromia 15% (Kedir *et al.,* 2016) [6], Adama city 15.6% (Roba *et al.,* 2016) [15], and Adwa town, Tigray 12.2% (Tsgehana *et al.,* 2016) [21]. The possible reason for this variation could be the difference in the study setting by which, unlike this study which was done only in rural adolescent girls, the above studies were done in both urban and rural areas by which healthy household environmental factors are more likely to be common than the rural setting. The other possible explanation for this difference could be adolescent related factors like eating disorder. The prevalence of thinness among adolescent girls of this study area was almost comparable with the national nutrition survey report of Ethiopia 14% (EHNRI, 2009/10) [5], with the study conducted in Karve district, Nepal 14.9% (Mansur et *al*., 2015) [10] and the study conducted in Amhara region 13.6% (Molla *et al*., 2015) [11].

The prevalence of thinness in this study was lower than the finding in Babile district, Oromia 21.6% (Kedir *et al.,* 2016) [6], Wukro town, Northern Ethiopia 21.6% (Yohannes *et al.,* 2015) [28] and Adwa town, Tigray 21.4% (Tsgehana *et al.,* 2016) [21]. The possible reason for this prevalence difference could be due to seasonal variation of the study period because this study was conducted during harvest season when the study participants easily access to food.

In this study meat frequency was associated with adolescent girls stunting. The adolescent girls who feed meat only 1-2 times per week were 2.382 times more likely stunted when compared with the adolescent girls who get meat more than or equal to 3 times per week. The possible reason for this factor could be since meat is a good source of iron and proteins less frequent eating of meat in combination with increased energy and protein

need of adolescent due to growth spurt or puberty, can lead to delayed or stunted height and weight.

The other factors which associated with stunting of adolescent in this study were numbers of meal per day. The adolescent girls who had less than 3 meals per day were 1.67 times more likely stunted as compared with adolescent girls who had greater or equal to 3 meal per day. This could be due to eating disorder of adolescent girls like repeat skipping of meals which leads to inadequate dietary intake. The other possible reason could be due to cultural influence like gender discrimination of rural adolescent girls.

According to this study thinness of adolescent girls was significantly associated with menstruation status. Adolescent girls who did not start their menses were 1.722 times more likely thin than adolescent girls who started. This result is in line with the study conducted in Eastern Tigray Ethiopia and Kenya. In Eastern Tigray of Ethiopia adolescent girls who did not start menarche were 2.6 times more likely to be wasted than adolescent girls who started (Weres *et al.,* 2015) [23]. This result is also consistent with study which was conducted in Kenya among school adolescent girls 12-18 years old which revealed the prevalence of thinness and stunting as decreased markedly with sexual maturation. BMI-for-age z scores and height-for-age z-scores were significantly associated with sexual maturation (P<0.001 and 0.001) (Leenstra *et al.,* 2005) [8]. The possible explanation for thin adolescent girls late to see their menarche; might be due to their low nutritional status that makes their menarche to delay.

The other factor that showed association with adolescent thinness was daily based diversified meal pattern of adolescents. Adolescent girls who had monotonies diet pattern on daily base were 2.35 times more likely to be thin as compared to adolescent girls who had always diversified food patterns on daily bases.

This factor is similar with the studies conducted in Adama city where adolescent girls who had monotonous diet were 2.52 times more likely to develop thinness as compared to those who had always diversified food on daily bases (Roba *et al.,* 2016) [15]. This factor may be related with the main food source of the study participants which is mainly based on low energy and low nutrient foods, such as cereals or tubers and is low in animal source foods.

Conclusion

This study revealed high proportions of adolescent girls were undernourished in rural community of Aseko district. Factors like frequency of meat consumption and number of meal per day were significantly associated with stunting and while factors like adolescent menstruation status and daily based diversified meal patterns were associated with thinness.

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