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Magnitude and Factor Associated with Thinness among High School Adolescents Students in Eastern Ethiopia: Neglected Public Health Concern

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Abstract

Background: Adolescence is the last chance for curbing the consequences of malnutrition for breaking the intergenerational cycle. Our world is home to 1.8 billion (24.66%) young people between the ages of 10 and 24. In Ethiopia, about 25% of the population are adolescents. However, adolescents are the neglected age group and there is little evidence documented on thinness among school adolescents in Ethiopia, particularly in the study area.

Objective: To assess the prevalence of thinness and associated factors among school adolescents in Dire Dawa city high schools Dire Dawa; Eastern Ethiopia.

Methods: A school-based cross-sectional study was conducted from May 25 to June 10, 2021, among 449 adolescent students selected using a simple random sampling. Data were collected through face-to-face interviews and anthropometric measurements were used to collect the data. The BMI-for-age Z score was calculated using the WHO Anthro-Plus. A binary logistic regression model was fitted with an odds ratio and 95% confidence levels. Statistical significance is declared at a p-value below 0.05.

Results: A total of 438 (98.2 %) were included in this study. The overall prevalence of thinness was 12.1% (95% CI: 9.1, 15.3). Educational status of adolescent mothers being primary education (AOR = 5.08; 95% CI: 1.50 - 17.12), having more than five family members (AOR = 3.42, 95% CI: 1.59 - 7.33), having 1000 - 2000 Birr family monthly income (AOR = 6.04; 95% CI: 2.17 - 16.85) were significantly associated with thinness.

Conclusion: The study revealed that the prevalence of thinness was high in the study area. Lower maternal education level, having more than five family members and lower monthly income of the family were independent factors associated with thinness among the respondents. Therefore, it would be good to consider the above-mentioned factors during the nutritional intervention of high school adolescents.

Keywords: *Adolescent; Dire Dawa; High School Students; Thinness*

Abbreviations

A/COR: Adjusted or Crude Odds Ratio; BMI: Body Mass Index; BAZs: BMI-for-Age; CM: Centimeter; CI: Confidence Interval; DDS: Dietary Diversity Score; FFQ: Food Frequency; Hr: Hour; NEP: Nutritional Education Programs; SD: Standard Deviation; SFP: School Feeding

Programs; TEM: Technical Error Measurements; UNICEF: United Nations International Children's Emergency Fund; WFP: World Food Program; WHO: World Health Organization

Background

The World Health Organization (WHO) defines adolescence as a young person between the ages of 10 and 19, the journey from childhood to adulthood [1]. Our world is home to 1.8 billion (24.66%) young people aged between 10 and 24 years, in developing countries youth have an 85% higher demographic weight, for example almost 26% in Salvador and in Ethiopia, about 25% of the Ethiopian population are teenagers [2,3].

Adolescent thinness is defined as the BMI-for-age (BAZs) Z score is below −2SD as compared to WHO reference point [4]. Adolescence is a potential window for people in which there is a chance of a slight catch-up increase and a final growth spurt; In particular, early adolescence after the first year of life is the period indispensable for rapid physical growth and changes in body composition, physiology, and endocrinology [5,6]. However, nutritional support at this age affects not only the well-being of young people, but also the well-being of the entire society [7]. Ensuring that young people can navigate effectively at this stage of existence will help break the cycle of poverty and create benefits for individuals, communities and countries around the world [8,9].

Despite the economic growth observed in developing countries, malnutrition, especially undernutrition, is still widespread among young people in low- and middle-income countries [10]. Over 10% of girls were underweight in Mauritius, Bangladesh, Maldives, Cambodia and Vietnam [11]. In Southeast Asia and Africa, a large number of adolescent girls suffer from chronic malnutrition [12,13]. Body mass indexes of adolescent girls were less than 20 in South Asia, Southeast Asia, East Africa, West Africa, and Central Africa, which adversely impacts their health and development, as well as that of their offspring, contributing to an intergenerational cycle of nutritional problems [14]. Adolescents in general received little attention in health and nutrition, with the exception of reproductive health issues. Since then, only preschool children and women of reproductive age have been considered nutritionally vulnerable groups in developing countries [15].

Ethiopia has made progress in the last year in combating malnutrition (stunting, wasting, thinness, and micronutrient deficiencies) but Ethiopia still has the highest incidence of thinning among sub-Saharan African countries [16]. According to the 2016 Ethiopian Health and Population Survey (EDHS), the median age at marriage is 16.5 and 12% of adolescents aged 15 - 19 are mothers or are pregnant with their first child [17]. Thinness in pregnant adolescents leads to an intergenerational cycle of nutritional problems that can lead to stillbirths, low birth weight, growth retardation, increased risk of maternal and neonatal mortality, cognitive developmental disorders and suboptimal productivity in adults and decreased performance [2].

According to the report of the Ethiopian Ministry of Health, most of the causes of thinness are due to poor care, poor economic situation and food insecurity; However, malnutrition can sometimes run in families [18]. The presence of malaria infections, smoking, alcohol and drug use, environmental pollution and domestic violence are predictors of undernutrition [19]. Also adolescence, father's occupation [20], poor dietary diversity scores, skipping meals, lack of access to nutritional information, living in a food insecure family [21], eating less than 3 times a day and having a family size of 5 people, Drinking source water, monthly income was a predictor of undernutrition among young girls [22,23]. According to the National Food Consumption Report, drab foods were common and there was a significant difference in leanness across the country [24]. Studies conducted in some parts of Ethiopia have shown that thinness, stunting and anemia in adolescents are major public health problems [25,26]. That is why today adolescents have earned the eyes of the world and improving nutrition is Ethiopia's second goal for sustainable development. Understanding nutritional status and its associated factors is crucial to addressing under undernutrition in this age group in a timely manner. No study examined thinness in the study area for best literature search. The research also focused on public and private colleges in urban areas, especially in cities characterized by ethnic diversity and

different socio-demographic and economic conditions. Therefore, this study was conducted to determine the prevalence of thinness and associated factors among adolescents in Dire Dawa city High School in Eastern Ethiopia.

Materials and Methods

Study setting and design

This school-based study was conducted in high schools of Dire Dawa city, which is located in the eastern part of Ethiopia, which is 515km to the east of Addis Ababa. In Dire Dawa, there are a total of thirteen high schools. The study was conducted from May 25 to June 10, 2021. The target population of this study was a adolescent students who have been attending high school and aged 10 - 19 years in the study area. Among these, a random sample of 449 adolescents was included in the sample. Disabled students who were unable to stand by themselves and those seriously ill were excluded.

Sample size determination and sampling procedure

The minimum sample required for the first objective was calculated using sample size estimation for a single proportion estimate. We assumed the prevalence of thinness among adolescents (32.2%) [32], a 5% significance level, at a 95% confidence level. The sample size has become 335. On the other hand, a sample size for a second objective was also estimated using various factors that are significantly associated with the outcome. We took a power of 80% and a 95% confidence interval. However, the samples estimated taking meals per day at AOR: 1.66 (exposed = 29.5% and unexposed = 17.3 %) [31]. The sample size has become 408, which is far above the required sample for the first objective. Thus, we took the larger sample size for the second objective and a 10% non-response rate to account for non-volunteers during data collection. Thus, a total of 449 samples were required to conduct the study and achieve the objectives.

To obtain the sample, simple random sampling techniques have been employed. Out of thirteen high schools, four high schools, namely St. Theresa and Bisrate Gabriel School (BGS), Medehanealem Secondary school, and Dire Dawa comprehensive secondary school (DDCSS) were selected using lottery methods considering the available resources. The total sample size was distributed proportionally to the schools. The sampling frame was students' identification numbers in their respective schools.

Variables of the study

The outcome variable was thinness (which is a composite indicator of under-nutrition). On the other hand, socio-demographic and family-level characteristics (age, sex, grade level, religion, family size, father's education level, mother's education level, father's occupation, mother's occupation, and family income), health and environmental factors (illnesses, availability of latrine, hand washing practice source of drinking water), and dietary diversity score (Grains, roots or tubers, Vitamin A-rich plant foods, other fruits or vegetables, meat, poultry, fish, seafood, eggs, pulses/legumes/nuts, milk and milk products, foods cooked in oil/fat and the number of meals per day) were the independent factors considered in this study.

Operational definitions

The term Adolescents refers to those individuals' ages is between 10 and 19 years old according to WHO definition, while thinness was defined as BMI-for-age for Z score below -2SD as compared to the WHO cutoff point [41]. High school is a structure of education system that includes students from Grades 9 - 10 [42]. Good dietary diversity score (when food items consumed above the mean value), while when food items consumed below the mean were categorized as poor diversity Score within the past 24 hr [43]. Unimproved drinking water sources: refers to using one of the following sources unprotected dug well, unprotected spring, cart with small tank/drum, tanker truck, and surface water (river, dam, lake, pond, stream, canal, irrigation channels), bottled water, while improved drinking water sources: Public taps or standpipes, tube wells or boreholes, protected dug wells, protected spring and rainwater collection [44].

Data collection procedures

A structured questionnaire was conducted through a face-to-face interview with adolescent students. In addition, anthropometric measurements (weight, and height measurements) were used to collect the data. The tool was developed in English and translated to local languages and pretested on 5% of the total sample (23 students) from un-sampled high school (Sabiyan Secondary School). Socio-demographic, dietary diversity, health and environmental factors information, and other variables were gathered. Food Frequency Questionnaire (FFQ) on cores of food groups (Grains, roots or tubers, Vitamin A-rich plant foods, other fruits or vegetables, meat, poultry, fish, seafood, Eggs, Pulses/legumes/nuts, Milk and milk products, Foods cooked in oil/fat) food consumption was applied to capture the dietary intakes and patterns over the past 24 hr [38-40,43]. Weight was measured at the nearest 0.1 kg using a digital weight scale. During weight measurement, each participant only wears a uniform. Likewise, height was measured to the nearest 0.1 cm using a stadiometer. During the measurement, each participant stood on the measuring board without shoes, with the right anatomical position, heels, buttocks, shoulders, and back of the head touching board the flat headpiece of the measuring board touched the crown of the head and formed a right angle.

Data quality assurances

To assure the quality of the data pretested questionnaire was used among 23 (5%) of the total sample. All study instruments were translated into local languages (Afan Oromo, Afe Somali, and Amharic) by a language translator and then back-translated to English to ensure clarity, wordings, and logical sequence of the questions. Proper training of the data collectors and supervisors was assured by demonstrating how to take anthropometric measurements and instruments calibrated every morning by placing standard calibration weights of 2 Kg iron bars on the scale to ascertain accuracy. Besides, height was measured using a measuring board with a precision of 0.1 cm. During data collection, close supervision was conducted on how the data collectors run and check for completeness, accuracy, and clarity. This quality checking was done daily after data collection then correction was made before the next data collection measurement. Each questionnaire was coded separately before analysis.

Data processing, analysis, and presentation

Data were checked for completeness, internal consistency and then coded and entered into Epi Data 3.1 computer software package. For further analysis, the data was exported to SPSS version 24 software and WHO Anthro-Plus software. A descriptive summary of variables was presented in terms of frequency and percentage by using a table and graph. For anthropometric data analysis, if the BMI-for-age Z-score is < -2SD from the median of the reference population, then the adolescent is thin. The outcome variable was categorized as “thin” and “not-thin”. A binary logistic regression was conducted to assess factors associated with thinness. Variables with a p-value below 0.25 and important variables were candidates for the multi-variable logistic regression model. Statistical significance was declared at a p-value below 0.05. The fitness of logistic regression models was checked using Hosmer and Lemeshow statistical tests. Crude and adjusted odds ratios with 95% confidence intervals were reported.

Results

Socio-demographic and economic characteristics

In this study, a total of 438 adolescents (98.2%) gave complete responses. Most adolescents 323 (73.7%) were aged (15 - 17), 195 (44.5%) of the respondents were female adolescents. Regarding educational level, 24 (5.5%) adolescents' fathers and 35 (8.0%) adolescents' mothers did not have formal education. Regarding family size, one-third of the 152 (34.7%) adolescents were living with members of five and above families. Regarding monthly adolescent family income, more than half of, 234 (53.4%) adolescents' families were earned > 5000 income monthly, whereas only 6 (1.4%) adolescents' families were earned < 1000 income monthly (Table 1).

Variables		Frequency (n)	Percentage (%)
Age	Mid adolescent (15 - 17)	323	73.7
	Late adolescents (18 - 19)	115	26.3
Grade	Grade 9	177	40.4
	Grade 10	261	59.6
Sex	Male	243	55.5
	Female	195	44.5
Religion	Orthodox	140	32.0
	Muslim	186	42.5
	Protestant	73	16.7
	Catholic	39	8.9
Father's Education	No formal education	24	5.5
	Primary education	55	12.6
	Secondary education	162	37.0
	College and above	197	45.0
Father's occupation	Merchant	122	27.9
	Daily laborer	8	1.8
	Farmer	27	6.2
	Government employee	281	64.2
Mother's Education	No formal education	35	8.0
	Primary education	163	37.2
	Secondary education	161	36.8
	College and above	79	18.0
Mother's occupation	House wife	254	58.0
	Merchant	71	16.2
	Daily laborer	20	4.6
	Farmer	31	7.1
	Government employee	62	14.2
Family size	≥ 5	152	34.7
	< 5	286	65.3

Monthly family income	< 1000	6	1.4
	1000 - 2000	27	6.2
	3000 - 4000	171	39.0
	> 5000	234	53.4
Availability of latrine	No	9	2.1
	Yes	429	97.9
Source of drinking water	Non improved	17	3.9
	Improved	421	96.1

Table 1: *Sociodemographic-related characteristics of school adolescents in Dire Dawa city high schools eastern Ethiopia, 2021 (n = 438).*

Nutrition and health-related characteristics of school adolescents

Almost all, 400 (91.3%) of the respondents did not ill in the past two weeks. Regarding the number of meals per day, the majority of the adolescents, 420 (95.9%), were consuming meals three times per day, whereas the other 7 (1.6%) of adolescents were consuming meals two times per day. Among the respondents, 430 (98.2%) were washed their hands before eating meals. In regard to the dietary diversity Score, 3.61 were the mean value for DDS, half of adolescents 224 (51.1%) were below the mean dietary diversity Score, whereas the others 214 (48.9%) of adolescents were above mean dietary diversity Score (Table 2).

Variables		Frequency (n)	Percentage (%)
Illness in the past two weeks	Yes	38	8.7
	No	400	91.3
Number of meals per day	Two times	7	1.6
	Three times	420	95.9
	Four times and above	11	2.5
Handwashing before eating	Yes	430	98.2
	No	8	1.8
Dietary Diversity Score	Below the mean DDS	224	51.1
	Above mean DDS	214	48.9

Table 2: *Diet, lifestyle, behavioral and environmental factors of school adolescents in Dire Dawa city high schools eastern Ethiopia 2021 (n = 438).*

Anthropometric results

The minimum and maximum heights of study subjects were 148 cm and 172 cm, respectively. The mean ± SD overall height of the participants was 160 ± 4.9 cm. Similarly, the minimum and maximum weights of study participants were 40.0 kg and 80 kg, respectively. The mean ± SD overall weight of the participants was 54.84 ± 7.16 kg. Similarly, the minimum and maximum age of study participants were 15 years and 19 years, respectively. The mean age of the study participants was 15.95 years (± 0.85 SD).

The mean heights of boys and girls were 161.50 ± 5.12 cm and 160.16 ± 4.52 cm, respectively. Similarly, the mean weights of boy and girl adolescents were 53.89 ± 6.67 kg and 56.03 ± 7.54 kg, respectively.

The mean *Z*-score of BMI-for-age of all adolescents was 0.09 which revealed the distribution of BAZ (Figure 1).

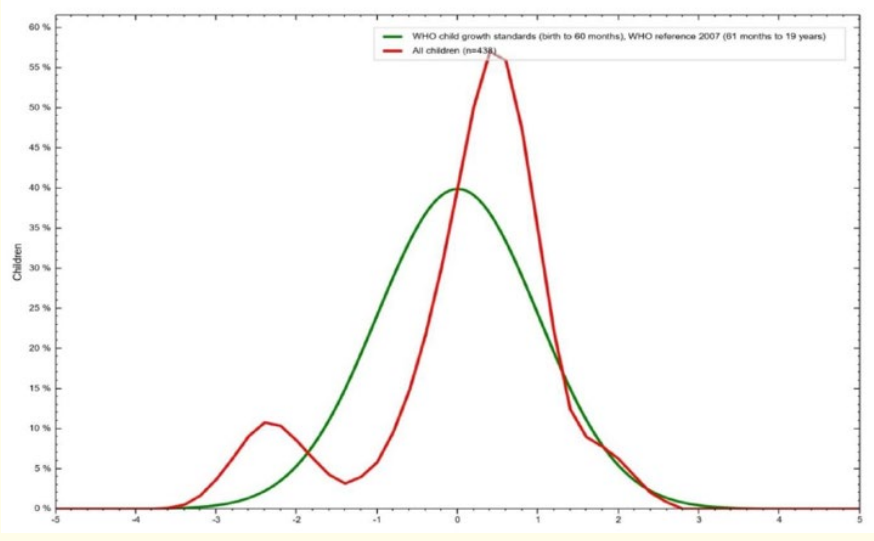

Figure 1: *BMI-for-age Z-score of school adolescents in Dire Dawa city high schools eastern Ethiopia, 2021 (n = 438).*

The mean *Z*-scores of BMI-for-age among boys and girls were -0.04 and 0.28 that showing the distribution of BAZ, respectively (Figure 2).

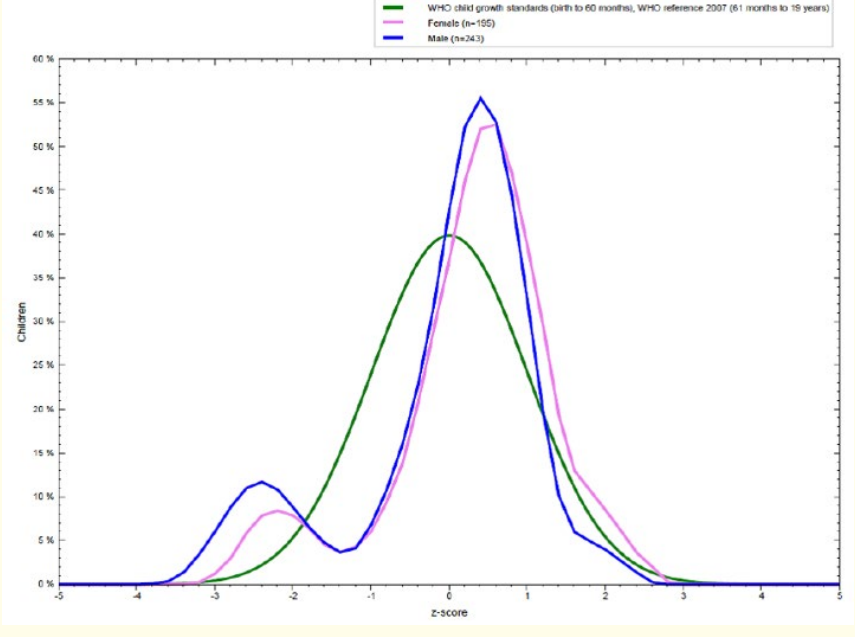

Figure 2: *BMI-for-age Z-score by sex result of school adolescents in Dire Dawa city high schools eastern Ethiopia, 2021 (n = 438).*

The overall prevalence of thinness among school adolescents in Dire Dawa high-schools was 12.1% (95% CI: 9.1, 15.3).

Factors associated with thinness

In the bivariate regression variables which were associated with dependent variables such as age, sex, father's education, father's occupation, mother's education, mother's occupation, family size, monthly family income, availability of latrine, source of drinking water, and dietary diversity score factors that are associated with thinness. On multivariable logistic regression model mother's education, family size, and monthly family income were significantly associated with thinness. Children whose mothers' educational status was primary was 5.08 times more likely to be thinner as compared to adolescent mothers who were in college and above their educational status (AOR = 5.08; 95% CI: 1.50, 17.12). Adolescent students who have family size ≥ 5 were 3.42 times more likely to be thin as compared to those adolescents who have < 5 family size (AOR = 3.42; 95% CI: 1.59, 7.33). Adolescents whose families earn a monthly income of 1000-2000 Birr were 6.04 times more likely to be thin as compared to greater than 5000 Birr family monthly income (AOR = 6.04; 95% CI: 2.17, 16.85) (Table 3).

Variables		Thinness		COR (95%CI)	AOR (95%CI)
Yes		No			
Age	Mid adolescent (15 - 17)	34	289	0.59 (0.32, 1.09)	0.56 (0.27, 1.16)
	Late adolescent (18 - 19)	19	96	1	1
Sex	Male	36	207	1.82 (0.99, 3.35)	1.83 (0.87, 3.81)
	Female	17	178	1	1
Father's Education	No formal education	6	18	3.00 (1.07, 8.43)	0.72 (0.07, 7.71)
	Primary education	10	45	2.00 (0.87, 4.57)	1.48 (0.43, 5.07)
	Secondary education	20	142	1.27 (0.34, 1.33)	1.76 (0.80, 3.86)
	College and above	20	180	1	1
Father's occupation	Merchant	17	105	1.52 (0.80, 2.91)	1.29 (0.51, 3.29)
	Daily laborer	2	6	3.14 (0.60, 16.30)	1.83 (0.27,12.44)
	Farmer	7	20	3.29 (1.28, 8.49)	0.31 (0.03, 3.76)
	Government employee	27	254	1	1
Mother's Education	No formal education	7	28	4.68 (1.27, 17.25)	2.23 (0.47,10.46)
	Primary education	23	140	3.08 (1.02, 9.23)	5.08(1.50, 17.12)*
	Secondary education	19	142	2.50 (0.82, 7.64)	3.09 (0.92, 10.44)
	College and above	4	75	1	1
Mother's occupation	House wife	23	231	0.67 (0.28, 1.58)	0.82 (0.31, 2.17)
	Merchant	9	62	0.97 (0.35, 2.72)	1.41 (0.44, 4.55)
	Daily laborer	4	16	1.69 (0.45, 6.34)	2.41 (0.54, 10.75)
	Farmer	9	22	2.76 (0.94, 8.08)	6.45 (0.75, 55.51)
	Government employee	8	54	1	1
Family size	≥ 5	33	119	3.68 (2.03, 6.69)	3.42 (1.59, 7.33)*
	< 5	20	266	1	1

Monthly family income	< 1000	2	4	5.35 (0.92, 31.04)	2.64 (0.24, 28.95)
	1000 - 2000	10	17	6.29 (2.54, 15.57)	6.04 (2.17, 16.85)**
	3000 - 4000	21	150	1.50 (0.78, 2.68)	1.15 (0.56, 2.35)
	> 5000	20	214	1	1
Availability of latrine	No	3	6	3.80 (0.92, 15.63)	1.41 (0. 12, 15.99)
	Yes	50	379	1	1
Source of drinking water	Non improved	4	13	2.34 (0.73, 7.44)	0.92 (0. 12, 6.94)
	Improved	49	372	1	1
Dietary Diversity Score	Poor DDS	36	188	2.22 (1.21, 4.08)	1.45 (0. 67, 3.12)
	Good DDS	17	197	1	1
Note: AOR = Adjusted Odd Ratio; CI = Confidence Interval, COR = Crude Odd Ratio; 1 = reference category, * = p-value < 0.05. **P-Value ≤ 0.001					

Table 3: *Binary and multivariate logistic regression analysis of factors associated with thinness among school adolescents in Dire Dawa city high schools eastern Ethiopia.*

Discussion

This study aimed to assess the prevalence of thinness and associated factors among adolescent students in Dire Dawa, city high schools, Dire Dawa; Eastern Ethiopia. Findings from this study revealed that the overall prevalence of thinness was 12.1% (95% CI: 9.1, 15.3) which is almost comparable with the study conducted in Finote Selam town 14.9% [33] and in Aw Barre refugee camp, Somali regional state 15.2% [40] and in this study factors like maternal education, family size, and family monthly incomes were significantly associated with the thinness of adolescent students.

The prevalence of thinness in this study area was higher than when compared to the finding of a study done in a south Asia country; India Tripura 8.1% [28]. On the other, it was lower than when compared to the finding of a study done in northern European country, Finland 18% [29]. Regarding India Tripura finding the possible explanation for this difference might be due to the difference between the study subjects in socioeconomic and geographical characteristics status like availability of technology for farming also could be a cultural difference in dietary intake, health care practices. In addition, the other reason for this discrepancy may be due to the fact developed countries are more likely exposed to a sedentary lifestyle which leads to weight gain/overweight, which was also evident at a low level of physical activity, and associated with overweight and obesity in Tripura's study. In regards to the Finland study, the possible discrepancy might be due to the cultural difference in dietary intake or type of meals and physical activity level. However, findings also indicated that dietary habits potentially, dieting with advanced age, especially in adolescent girls, reported as one of the reasons for the higher prevalence of thinness among Finland study.

The prevalence of thinness in this study area was lower than the studies conducted in Adwa Town 21.4% [31], Lay Guyint woreda 29.0% [35], Jimma Town 29.2% [36], Wolaita and Hadiya zone; Southern Ethiopia 27.5% [37], Babile district 21.6% [39]. This variation might be due to economical difference of each study area and the other possible explanation for this discrepancy could be in the study setting by which, this study which only included those high school adolescents living in the urban area unlike this, the above studies were done both in urban and rural setting finding from a study conducted in the Adwa Town, Lay Guyinta, wolaita, and Hadiya Zone; Southern Ethiopia which indicated that those adolescents being resident in the rural setting is more likely to be exposed to socio-demographic and environmental factors like poor health status and health service, unavailability of latrine, poor handwashing practice and poor knowledge of parents about thinness and its consequence than the urban setting [31,35,37].

However, the prevalence of thinness in Tigray regional state, northern Ethiopia; Hawzen woreda/district was 32.2% [32], which is much higher compared to this study. This discrepancy in the prevalence of thinness might be a difference in socio-demographic, socio-economic status, and cultural difference in dietary habits like size and frequency of meals and nutrient composition (balanced diet)/type of meals, adolescent's health status, and physical activity level between the cities and town/district. In addition to this, the other possible explanation for this difference could be the time gap between the study periods.

The prevalence of thinness in this study area was higher as compared to other studies conducted in Dangila town 7.1% [34], Addis Ababa 6.2% [38]. This variation between Dangila town and Dire Dawa city studies might be due to the difference in agro-ecological factor-like types of agricultural product, an economic difference of each study area, and the possible discrepancy regarding Addis Ababa; might be due to socio-demographic and economic status like urbanization and sedentary lifestyles/decline in physical activity, in developing countries like Ethiopia weight gaining might be considered as a sign of healthiness and those families in high socioeconomic status might be accessible for fat dense foods and energy-rich food.

This study indicated that the educational status of adolescents' mothers being on Primary education level was 5.08 times more likely to be thinner compared to those adolescents whose mothers were in College and above their Educational status. This finding is consistent with a study conducted in Finland nationally [29] and Adwa Town, North Ethiopia [31]. This difference observed in this study might be explained by the fact that lower educational status of mothers are less likely to be aware of nutrition, hygiene, and health care which can greatly impact the nutritional status of their children in addition to this they are also less likely to have a good job opportunity which leads to low contribution to the total family income this places the whole family at risk of food availability in households and not meeting their nutritional requirements.

This study indicated that adolescent students who lived in a family size of ≥ 5 were 3.42 times more likely to be thin compared to those adolescent students who had lived in family size of < 5. This finding was similar with a study done in Adwa Town, north Ethiopia [31], Dangila town [34] and Wolaita and Hadiya zone; Southern Ethiopia [37]. This might be due to the large family size hampers food security status of the household members; this will lead to sharing food when the household has insufficient food which will compromise to availability and access to a balanced diversity diet at an individual's level. The other possible explanation for this difference could be due to increased family size, mostly occurring in uneducated parents who are more likely to accept and practice food taboos that affect adolescents.

Another important determinant factor of thinness was low family monthly incomes. Those adolescents whose family's monthly incomes from 1000 - 2000 birr were 6.04 times more likely to be thin compared to those whose family's monthly incomes greater than 5000 Birr. This finding was in line with a result reported from Finote Selam town [33], this might be due to the direct relationship between income and living standards, the better income level of the family would enhance the nutrition status of the adolescents.

Conclusion

The prevalence of thinness was high in the study area. The study findings indicated that the mean Z-scores of BMI-for-age was higher in boys than girls and BMI-for-age scores of all adolescents were found to be above the WHO child growth standards reference 2007. Factors like lower mother's education level, having more than five family members and lower monthly income of the family were variables that significantly associated with thinness among the respondents. Public health interventions should be considered to address those thin school adolescents. The city health and education bureau should work in collaboration with other organizations (NGOs) to combat thinness and the city health office should implement nutritional interventions through school feeding programs (SFP) with nutritional education programs (NEP). The city health office should encourage promoting a family planning and healthy lifestyle to comprise household food security. Teachers, schools administrative, with collaborating with the city health and education bureau they should give

comprehensive and continuous information/education on nutrition by emphasizing the importance of dietary diversity, adequate feeding and the positive effect of nutrition on educational achievement to address adolescent thinness problems. In addition, both adolescents and parents should participate in NEP to get information about healthy eating habits and its importance.

Ethical Considerations

Before starting of the data collection process, Dire Dawa University School of medicine and college of health sciences Institutional Health Research Ethics Review Committee (IHRERC) was secured by ethical clearance and Dire Dawa University was write Official letter to hospital and health centers. Informed voluntary written and signed consent was obtained from each participant after explaining the purpose and benefits of the study. The data collector were trained to respect the culture of the people in these communities throughout the data collection process. Confidentiality of the study participants' information also ensure.

Declaration of Informed Voluntary Consent

I have read/ \was read to me the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I was informed that I have the right to withdraw from the study at any time or not to answer any question that I do not want. Therefore, I declare my voluntary consent to participate in this study with my initials (signature).

All methods were carried out in accordance with relevant ethical guidelines and regulations.

Consent for Publication

"Not applicable" in this section.

Availability of Data and Material

"Availability of Data and Materials at any time if required".

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

Zerihun Tariku: Conception and design, acquisition of data, drafting the article and final approval of the version to be published.

Eyob Eshete: Analysis and interpretation of data revising it critically for important intellectual content; and final approval of the version to be published.

Frehiwot Tesfaye: Conception and design, acquisition of data, drafting the article and final approval of the version to be published.

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