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Nutritional status of adolescents in selected government and private secondary schools of Addis Ababa, Ethiopia

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Abstract: *Background:* Changes in the nutritional intake combined with increasingly sedentary life styles and increasing urbanization has led to the emergence of chronic disease as a major new health threat. *Objective:* To assess and compare nutritional status of adolescents and analyze the risk factors associated to/with overweight/obesity in government and private secondary schools of Addis Ababa, 2012. *Methods:* A comparative cross sectional study comprising 1024 adolescents of government and private secondary schools of Addis Ababa was conducted from February 02, 2012 to June 28, 2012. Information on socio-demographic data, eating habits and physical activity was collected using interviews. Measurements on weight and height were made using standardized weighing scales and measuring boards, respectively. Height-for-age and body mass index-for-age were compared to the 2007 WHO growth reference. Data were entered using Epi info version 3.5.1, WHO AnthroPlus and analyzed using SPSS version 16. *Results:* Overall, the prevalence of stunting (low height-for-age), underweight (low body mass index-for-age) and overweight/obese (high body mass index-for-age) in all school adolescents was 7.2% (95% CI; 5.8, 9.0), 6.2% (95% CI; 4.9, 8.0) and 8.5% (95% CI; 6.9, 10.4), respectively. Adolescents in government schools were significantly more likely to be undernourished [stunting; 51(10.0%) versus 23(4.5%) and underweight; 36(7.0%) versus 28(5.5%)] compared to their counterparts in private schools (P-value <0.05). Adolescents in private schools were overweight/obese compared to those in government schools [65(12.7%) versus 22(4.3%); OR=3.2 (95% CI; 1.9, 5.3)]. *Conclusions and recommendations:* The findings of this investigation showed that being in a private school, lacking daily breakfast and consumption of animal products more than once a day are significantly associated with overweight/Obese during adolescence. Results of this study emphasize the need for educational interventions at early ages involving the whole family to promote optimal nutritional status.

Keywords: Comparative Cross Sectional, Nutritional Status, Adolescents, Addis Ababa, Ethiopia

1. Introduction

Adolescence is a decisive period of development because it represents the transition between life as a child, and life as an adult covering the ages between 10-19 years. During this crucial period, dietary patterns have vital impact on lifetime nutritional status and health [1, 2]. Increased nutritional needs at this juncture relate 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 during this period. However, adolescents face a series of serious nutritional challenges which would affect this rapid growth spurt as well as their health as adults [3].

The main nutritional problems affecting adolescent populations worldwide include under nutrition (in terms of stunting and wasting), overweight and obesity which are emerging public health problems during this time [3-5]. Worldwide, 10% of adolescents are overweight with obesity prevalence varying between 2-3%. The global averages reflect prevalence that varies from 10% in Africa and Asia to more than 20% in the USA and Europe [6, 7]. The nutrition and epidemiologic transition has its own impact on changes

in diet and activity patterns, leading to the development of a double burden of malnutrition. The changes in the nutritional intake combined with increasingly sedentary life styles resulting from food market, globalization and increasing urbanization has led to the emergence of chronic disease as a major new health threat [6, 8, 9]. Adolescent obesity is associated with serious medical problems, including high blood pressure, adverse lipoprotein profiles, diabetes mellitus, atherosclerotic cerebrovascular disease, coronary heart disease, colorectal cancer, and death from all causes as well as lower educational attainment and higher rates of poverty [10, 11].

Adolescence is a period of transition between childhood and adulthood and also a significant period of human growth and maturation. Poor nutritional status during adolescence is an important determinant of health outcomes. Short stature in adolescents resulting from chronic under nutrition is associated with reduced lean body mass and deficiencies in muscular strength and working capacity [12]. Adolescents receive very little attention; as a result, there is limited understanding of the problem of dual burden and how best to manage it. The newly developed 2007 World Health Organization (WHO) growth reference for children and adolescents, however, simplify the problem and is used by this time for the assessment of thinness (low BMI(body mass index)-for-age), overweight and obesity (high BMI-for-age) and stunting (low height-for-age)[6, 13].

The increase in the prevalence of obesity in children and adolescents is a reality in all developed or developing countries associated with serious medical problems and lower educational attainment. It also dramatically increases the risk of adult obesity which is alarming because obesity is credited with 400,000 deaths annually in the United States [10]. A cross sectional study conducted on prevalence of childhood and adolescent overweight and obesity among elementary schools in Addis Ababa indicated that prevalence of underweight (BMI for age less than 5^{th} percentile), overweight (BMI for age 85^{th} percentile and above) and obesity (BMI for age 95^{th} percentile and above) were 13%, 7.6% and 0.9%, respectively [14]. A study conducted on nutritional status of adolescent girls from rural communities of Tigray, northern Ethiopia, showed that the prevalence of stunting and thinness were 26.5% and 58.3%, respectively [3]. Another study conducted in Ambo town showed that underweight was prevalent in males than females (29.8% versus 24.6%) with total prevalence of 27.5% whereas overweight was more prevalent in females than in males (3.8%% versus 1.7%) with overall prevalence of 4.3% [2].

The WHO and FAO (Food and Agriculture Organization) expert group found convincing evidence that high intake of energy dense foods is a risk factor for obesity. It also found that heavy marketing of fast foods and high intakes of sugar sweetened drinks were probable risk factors and that large portion sizes was a possible risk factor for obesity [10]. Changes in patterns of physical activity and the adoption of more sedentary lifestyles are likely to be important factors behind obesity. A study showed that only 31 % of US adults report that they engage in regular leisure-time physical activity (defined as either three sessions per week of vigorous physical activity lasting 20 minutes or more or five sessions per week of light-to-moderate physical activity lasting 30 minutes or more). About 35 % of high school students report that they participate in at least 60 minutes of physical activity on 5 or more days of the week, and only 30% of students report that they attend physical education class daily. As children get older, participation in regular physical activity decreases dramatically [16]. An Independent Television Commission survey conducted on England showed that 4-15 years old children watch Television (Tv) approximately 2.5 hours of a day. The research also showed that a strong correlation between the number of hours spent watching Tv and increased risk of obesity [15].

In general, there is no documented study done on adolescent nutritional status in Addis Ababa. Therefore, examination of the two extremes of malnutrition may provide insight into the nature of dual burden and how to direct prevention strategies, both for the immediate problem of underweight, and the rapidly increasing problem of overweight/obesity in adolescents. This study, is therefore, aimed at assessing the level of adolescent nutritional status and identifying factors contributing to adolescent overweight and obesity in the selected government and private secondary schools of Addis Ababa.

2. Materials and Methods

2.1. Study Design, Area and Period

A School based cross-sectional comparative study was conducted among randomly selected government and private secondary school adolescents of Addis Ababa from February 02, 2012 to June 28, 2012.

Sample size: The sample size was calculated using two-sample proportion formula, P1(14%) the prevalence of overweight/obesity among adolescents in government high schools from a study conducted elsewhere [22, 25], and P2(24 %) prevalence of overweight/obesity among adolescents in private high schools (a 10% difference was assumed to signify public health significance for lack of previous studies). Taking Pooled population, P= 19%, $Z\ \alpha/_2$ = 1.96 at 95% level of confidence, Z_β = 0.84 for 80% power of the test, r = 1, Proportion of group 1 to group 2 (Government to Private) was taken as equal 1:1, n1 was calculated to be 240 and n_2=240, thus n was 480. Adding 5% non-response rate gives the total sample size of 504. Considering design effect, 2(504 x 2) the sample size was calculated to be 1008. Based on these assumptions, the required sample size was 1008 but later it was adjusted to 1024(512 from government and 512 from private secondary school students) to get equal number of students from each section (cluster).

Sampling technique: Multi stage sampling method was used to select the study participants. Out of the 39 high schools constituting 13 government and 26 private schools, 12(4 government and 8 private schools) were randomly

selected. Secondly, using lottery method 64 clusters (32 clusters from each school type) were identified considering the available resource and different age distribution. From each of the selected 12 schools all sections of grade 9, 10, 11 and 12 were separately enlisted, two sections from each grade in government and one section from each grade in private schools were randomly selected using lottery method to identify 64 clusters (32 clusters from each school type). Out of each selected section (cluster), 16 eligible subjects were randomly selected using systematic random sampling. Those who had obvious physical deformity and were pregnant during data collection were excluded from the study.

Quality control measures: A standardized questionnaire was used, containing the variables except for physical activity which was assessed using the standard questionnaire "International Physical Activity Questionnaire (IPAQ)". The food consumption was evaluated using the standard foods frequency questionnaire for adolescents classified as: (f_1) never; (f_2) less than once a month; (f_3) one to three times per month; (f_4) once a week; (f_5) two to four times a week; (f_6) once per day and (f_7) more than twice per day. Body weight was measured using a standard digital balance with a precision of 0.1Kg. The students wore only light clothes during measurement of body weight. The scales were carefully handled and 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.

Data analysis: Data was entered using Epi info version 3.5.1. The WHO 2007 growth reference was used as a standard reference for classifying nutritional status of adolescents using WHO Anthroplus software. SPSS software version 16 was used for statistical analysis. Descriptive statistics and Logistic regression analysis were used as appropriate. Statistical significance was set at $p < 0.05$.

2.2. Study Variables

Dependent Variables: Overweight/obesity, Underweight, Stunting

Independent variables: Sex, Age, Educational status of the family, Marital Status, Religion, Economic status, Eating habit, Physical activity, Sedentary lifestyle.

Ethical Considerations: Ethical clearance and approval was obtained from the Research Ethics Committee at the School of Public Health, Addis Ababa University. Further permission was obtained from each school. The students were informed about the objective of the study and then data was collected after oral consent was obtained from each student.

3. Results

3.1. Socio-Demographic Characteristics

A total of 1024 students participated in the study giving a response rate of 100%. As displayed in Table 1, out of the 1024 respondents, 512(50.0%) were from government schools, 521 (50.9%) males, 606 (59.2%) belonged to the age group 17-19 years and 1011 (98.7%) were single. Majority (67.0%) of the respondents were Christian Orthodox followed by Muslim (19.6%). Four hundred ninety four (48.2%) fathers and 343(33.5%) mothers of the students were reported to have completed grade12, respectively. Average family size of the students household was 6 (SD=2.2). Regarding occupational status, 262(25.6%), 223(21.8%) and 328(32%) of fathers' occupation and 149(14.6%), 160(15.6%) and 246(24%) of mothers' occupation were private employees, civil servants, and merchants, respectively.

Table 1. *Socio-demographic characteristics of adolescents among government and private secondary schools of Addis Ababa, 2012.*

Variables	School type		Total	P- Value
	Government	Private		
	n(%)	n(%)	N (%)	
Sex				
Male	248(48.4)	273(53.3)	521(50.9)	0.12
Female	264(51.6)	239(46.7)	503(49.1)	
Age group				
13-16	175(34.2)	243(47.5)	418(40.8)	<0.01
17-19	337(65.8)	269(52.5)	606(59.2)	
Religion				
Orthodox	332(64.8)	354(69.1)	686(67)	
Protestant	53(10.4)	58(11.3)	111(10.8)	<0.05
Muslim	119(23.2)	82(16.0)	201(19.6)	
Others	8(1.6)	18(3.6)	26(2.6)	
Marital Status				
Single	508(99.2)	503(98.2)	1011(98.7)	0.54
Married	3(0.6)	7(1.4)	10(1.0)	
Divorced/ widowed	1(0.2)	2(0.4)	3(0.3)	

3.2. Nutritional Status of Adolescents

As indicated in Table 2, the mean age, height, and weight were 16.8 years, 162.8 cm, and 53.2 kg, respectively. BAZ (BMI-for-Age Z-score) and HAZ (Height-for-Age Z-score) of the adolescents were -0.48, and -0.72, respectively. Males were taller and heavier in both government and private schools on average by 10 cms and 4 Kgs, respectively. Mean BAZ and HAZ were significantly higher in private schools than government schools with mean difference of 0.24 (95%

CI; 0.11, 0.36) and 0.36 (95% CI; 0.25, 0.46) respectively with P<0.01. Mean BAZ was also significantly higher in females than males with mean difference of 0.49 (95% CI; 0.37, 0.62) with P<0.01.

Table 2. *Mean age, height, weight, BAZ and HAZ of adolescents by sex among government and private secondary schools of Addis Ababa, 2012.*

Characteristics (Mean)	Government Schools (n=512)			Private schools (n=512)			Over all (n=1024)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Age (years)	16.9	17.1	16.9	16.6	16.6	16.6	16.8	16.9	16.8
Height (cm)	166.4	156.9	161.5	169.4	158.2	164.2	167.9	157.6	162.8
Weight (kg)	53.0	50.2	51.6	57.1	52.3	54.8	55.1	51.2	53.2
BAZ	-0.91	-0.31	-0.6	-0.55	-0.14	-0.36	-0.72	-0.23	-0.48
HAZ	-0.94	-.87	-0.9	-0.48	-0.62	-0.54	-0.7	-0.75	-0.72

The mean BMI-for-age and height-for-age Z-scores were compared to the 2007 WHO growth reference population (Figure 1, Figure 2). Both Z-scores of the study population were below the mean scores of the WHO growth reference population. The overall prevalence of stunting (low height-for-age), underweight (low BMI-for-age) and overweight/obese (high BMI-for-age) in all school adolescents was 7.2% (95% CI; 5.8, 9.0), 6.2% (95% CI; 4.9, 8.0) and 8.5% (95% CI; 6.9, 10.4) respectively (Figure 3).

Comparison of nutritional status based on school type showed that more adolescents are underweight and stunted in government schools than private schools (7.0% versus 5.5%; P-value 0.30) and (10% versus 4.5%; with P <0.01) respectively.

Conversely, more students in private schools are significantly overweight/obese compared to those in government schools (12.7% versus 4.3%; with P <0.01) (Figure 3). Comparison of nutritional status of adolescents based on sex is indicated in Figure 4. Accordingly, males are significantly underweight than females (9.8% versus 2.6%; with P<0.01). On the other hand, more females were considerably obese compared to males (11.3% versus 5.8%; with P <0.05).

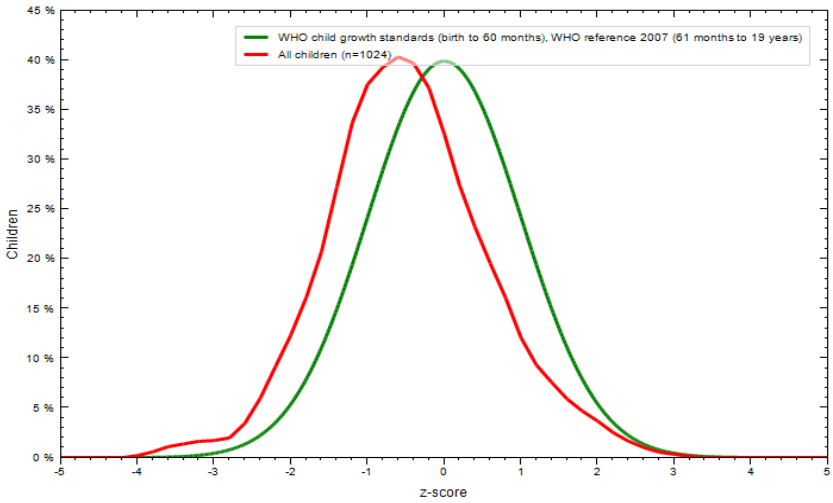

Figure 1. *Comparison of BMI- for-age (BAZ) of the study population with the 2007 WHO growth reference populations (n=1024).*

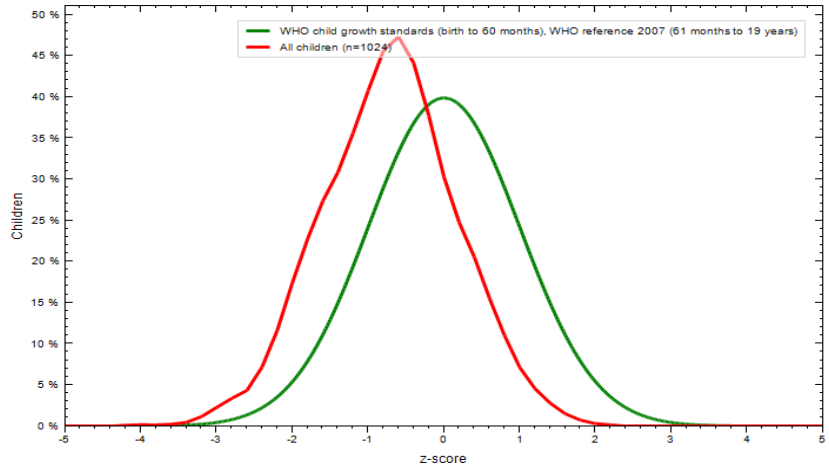

Figure 2. *Comparison of Height-for-age (HAZ) of the study population with the 2007 WHO reference populations (n=1024).*

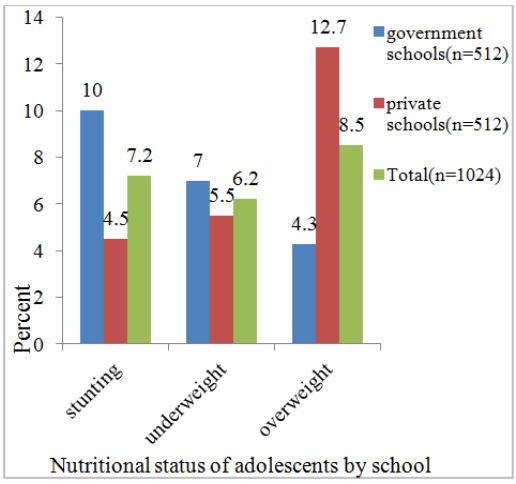

Figure 3. *Nutritional status of adolescents among government and private secondary schools, Addis Ababa, 2012(n=1024).*

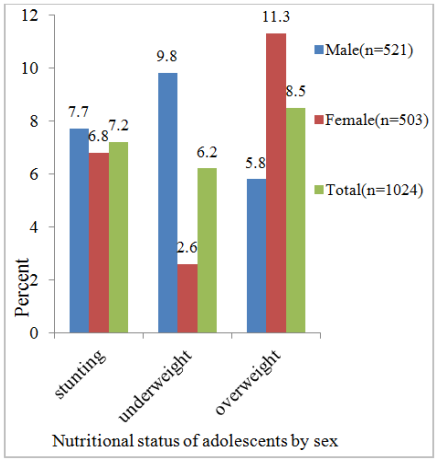

Figure 4. *Nutritional status of adolescents by sex in government and private secondary schools of Addis Ababa, 2012(n=1024).*

The mean BAZ for females were found to be comparable to 2007 WHO growth reference while the mean BAZ for males were below the mean scores of the WHO growth reference population. The mean HAZ of both sexes was comparable but below the mean Height-for-age Z-score of the 2007 WHO growth reference population.

3.3. Meal Pattern and Physical Activity

As indicated in Table 3, consumption patterns of adolescents for various foods from eight different food groups were studied with the help of Food Frequency Questionnaire (FFQ). Of the study subjects, 51(5%) took milk and milk products more than once a day, 78(7.6%) took meat, egg and fish more than once a day.

Eating Habit: Frequency of meal pattern of participants was three meals per day i.e. breakfast, lunch and dinner which were typical meal patterns. From the total sampled participants, 766(74.8%) took breakfast daily, 239(23.3%) took breakfast sometimes and 19(1.9%) never took breakfast at all. The majority, 858(83.3%) took lunch daily which was the main meal of the day and 140(13.7%) took lunch sometimes while 26(2.5%) never took lunch. Seven hundred seventy one (75.3%) took dinner regularly all days of the week, 219(21.4%) took dinner sometimes and 34(3.3%) never took dinner. School recess and snack was taken daily by 465(45.4%) and 553(54%) of the respondents.

Sedentary life style of the participants showed that 483(47.2%) spent more than two hours per day on TV, Video games and Computer; 23.9%, 51.6%, and 24.5% of the participants slept <6 hrs, 6-9 hrs and >9 hrs per day, respectively.

Concerning physical activity, adolescents were evaluated using International Physical Activity Questionnaire (IPAQ). Data collected with IPAQ questions were analyzed as categorical variables. The categories are 'low' (no activity is reported or some activity is reported but not enough to meet Categories 'moderate' or 'high'), 'moderate' (5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 minutes per week) and 'high' (7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 minutes per week). Accordingly 354(34.6%), 660(64.5%) and 10(1%) were categorized as having low, moderate and high physical activity respectively, with males being more active ($P < 0.01$) (Table 4).

Table 3. *Meal pattern according to Food Frequency Questionnaire (FFQ) of adolescents among government and private secondary schools of Addis Ababa, 2012.*

Variables	Level	School type		Total(n=1024) Number (%)	P-value
		Government (n=512) n(%)	Private(n=512) n(%)		
	Two to four times per week	8(1.6)	17(3.3)	25(2.4)	
Cereal & grains	Once a day	102(19.9)	63(12.3)	165(16.1)	<0.01
	Twice or more per day	402(78.5)	432(84.4)	834(81.5)	
	Never	23(4.5)	21(4.1)	44(4.3)	
	Less than once per month	52(10.2)	17(3.3)	69(6.7)	
Vegetables	One to three times per month	72(14.1)	38(7.4)	110(10.7)	<0.01
	Once a week	133(26.0)	113(22.1)	246(24.0)	
	Two to four times per week	162(31.6)	190(37.1)	352(34.4)	

Variables	Level	School type		Total(n=1024) Number (%)	P-value
		Government (n=512) n(%)	Private(n=512) n(%)		
	Once a day	51(10.0)	96(18.8)	147(14.4)	
	Twice or more per day	19(3.7)	37(7.2)	56(5.5)	
	Never	15(2.9)	6(1.2)	21(2.1)	
	Less than once per month	78(15.2)	17(3.3)	95(9.3)	
	One to three times per month	76(14.8)	46(9.0)	122(11.9)	
Fruits	Once a week	143(27.9)	103(20.1)	246(24.0)	<0.01
	Two to four times per week	125(24.4)	167(32.6)	292(28.5)	
	Once a day	57(11.1)	126(24.6)	183(17.9)	
	Twice or more per day	18(3.5)	47(9.2)	65(6.3)	
	Never	80(15.6)	43(8.4)	123(12.0)	
	Less than once per month	97(18.9)	37(7.2)	134(13.1)	
	One to three times per month	110(21.5)	72(14.1)	182(17.2)	
Milk, Yogurt & cheese	Once a week	109(21.3)	88(17.2)	197(19.2)	<0.01
	Two to four times per week	62(12.1)	105((20.5)	167(16.3)	
	Once a day	37(7.2)	133(26.0)	170(16.6)	
	Twice or more per day	17(3.3)	34(6.6)	51(5.0)	
	Never	54(10.5)	6(1.2)	60(5.9)	
	Less than once per month	146(28.5)	35(6.8)	181(17.7)	
	One to three times per month	119(23.2)	65(12.7)	184(18.0)	
Meat, egg & fish	Once a week	105(20.5)	99(19.3)	204(19.9)	<0.01
	Two to four times per week	60(11.7)	180(35.2)	240(23.4)	
	Once a day	16(3.1)	61(11.9)	77(7.5)	
	Twice or more per day	12(2.3)	66(12.9)	78(7.6)	
	Never	350(68.4)	385(75.2)	735(71.8)	
	Less than once per month	89(17.4)	62(12.1)	151(14.8)	
	One to three times per month	30(5.8)	26(5.1)	56(5.5)	
Beans	Once per week	22(4.3)	18(3.5)	40(3.9)	<0.05
	Two to four times per week	12(2.3)	10(2.0)	22(2.1)	
	Once a day	9(1.8)	8(1.6)	17(1.7)	
	Twice or more per day	-	3(0.5)	3(0.2)	
	Never	60(11.7)	3(0.6)	63(6.2)	
	Less than once per month	135(26.4)	45(8.8)	180(17.6)	
	One to three times per month	79(15.4)	54(10.5)	133(13.0)	
Sweet & sugars	Once a week	76(14.8)	99(19.3)	175(17.1)	<0.01
	Two to four times per week	76(14.8)	111(21.7)	187(18.3)	
	Once a day	60(11.7)	113(22.1)	173(16.9)	
	Twice or more per day	26(5.1)	87(17.0)	113(11.0)	
	Never	309(60.4)	337(65.8)	646(63.1)	
	Less than once per month	107(20.9)	65(12.7)	172(16.8)	
	One to three times per month	46(9.0)	43(8.4)	89(8.7)	
Fat	Once a week	35(6.8)	23(4.5)	58(5.7)	<0.01
	Two to four times per week	13(2.5)	27(5.3)	40(3.9)	
	Once a day	2(0.4)	4(0.8)	6(0.6)	
	Twice or more per day	-	13(2.5)	13(1.3)	

Table 4. *Frequency of meal, sedentary lifestyle and physical activity of adolescents among government and private secondary schools of Addis Ababa, 2012.*

Variables	School type			P-value
	Government	Private	Total	
	(n=512) n(%)	(n=512) n(%)	(n=1024) Number (%)	
Frequency of meal per day				
Once a day	7(1.4)	0	7(0.7)	
Twice a day	53(10.4)	20(3.9)	73(7.1)	<0.01
Three times a day	254(49.6)	182(35.5)	436(42.6)	
More than three times a day	198(38.7)	310(60.5)	508(49.6)	
Sleeping hours per day				
< 6 hrs	125(24.4)	120(23.4)	245(23.9)	
6-9 hrs	250(48.8)	278(54.3)	528(51.6)	0.16
9hrs	137(26.8)	114(22.3)	251(24.5)	
Transport				
Foot	360(70.3)	141(27.5)	501(49.0)	
Bicycle	14(2.7)	12(2.3)	26(2.5)	<0.01
Car	138(27.0)	359(70.2)	497(48.5)	
Time spent on TV, Video games and computer per day				
< 30 min	107(20.9)	56(0.9)	163(15.9)	
30-60 min	83(16.2)	69(13.5)	152(14.8)	
60-90 min	66(12.9)	58(11.3)	124(12.1)	<0.01
90-120 min	49(9.6)	53(10.4)	102(10)	
>2 hours	207(40.4)	276(64.0)	483(47.2)	
Physical activity				
Low	135(26.4)	219(42.8)	354(34.6)	
Moderate	367(71.7)		660(64.5)	<0.01
High	10(2.0)	293(57.2) -	10(1.0)	

Table 5. *Contextual factors of overweight/obesity among adolescents in government and private Secondary schools of Addis Ababa, 2012.*

Variables	Overweight/obesity		Crude OR (95% CI)	Adjusted OR (95% CI)
	Yes	No		
	n(%)	n(%)		
Socio-demographic variables				
Type of School				
Private	65(12.7)	447(87.3)	3.24(1.96-5.34)*	2.23(1.17-4.24)*
Government	22(4.3)	490(95.7)	1.00	1.00
Sex				
Female	57(11.3)	446(88.7)	2.09(1.32-3.31)*	1.63(0.97-2.75)
Male	30(5.8)	491(94.2)	1.00	1.00
Age			0.80(0.67-0.92)	0.85(0.72-1.01)
Family size				
More than five	45(9.3)	437(90.7)	1.23(0.79-1.90)	
Five or less	42(7.7)	500(92.7)	1.00	
Father's educational status				
> grade 8	71(10.2)	622(89.8)	2.25(1.29-3.93)*	1.43(0.72-2.85)
≤ grade 8	16(4.8)	315(95.2)	1.00	1.00
Mother's educational status				
> grade 8	57(11.7)	430(88.3)	2.24(1.41-3.55)* 1.00	1.10(0.60-2.00) 1.00
≤ grade 8	30(5.6)	507(94.4)		
Eating Habits Number of meals				
≤ 3 meals/day	55(10.7)	461(89.3)	1.78(1.13-2.79)*	1.92(1.12-3.28)*
> than 3 meals/day	32(6.3)	476(93.7)	1.00	1.00
Frequency of breakfasting				
Not daily	41(15.9)	217(84.1)	2.96(1.89-4.63)*	2.25(1.36-3.75)*
Daily	46(6.0)	720(94.0)	1.00	1.00
Frequency of School recess				
Daily	43(9.2)	422(90.8)	1.19(0.77-1.85)	
Not daily	44(7.9)	515(92.1)	1.00	
Frequency of Lunch				

Variables	Overweight/obesity		Crude OR (95% CI)	Adjusted OR (95% CI)
	Yes	No		
	n(%)	n(%)		
Daily	67(7.8)	791(92.2)	0.618(0.361.05)	
Not daily	20(12.0)	146(88.0)	1.00	
Frequency of Snack				
Daily	44(8.0)	509(92.0)	0.86(0.55-1.34)	
Not daily	43(9.1)	428(90.9)	1.00	
Frequency of Dinner				
Not daily	42(16.6)	211(83.4)	3.21(2.05-5.02)*	1.62(0.96-2.76)
Daily	45(5.8)	726(94.2)	1.00	1.00
Consumption of fast-food				
Daily	16(9.5)	152(90.5)	1.16(0.66-2.06)	
Not daily	71(8.3)	785(91.7)	1.00	
Consumption of Cereals				
> Once a day	17(8.9)	173(91.1)	1.07(0.62-1.87)	
≤ Once a day	70(8.4)	764(91.6)	1.00	
Consumption of Vegetables				
≥ Once a day	25(12.3)	178(87.7)	1.7(1.05-2.81)*	1.00(0.57-1.78)
< Once a day	62(7.6)	759(92.4)	1.00	1.00
Consumption of Fruit				
≥ Once a day	33(13.3)	215(86.7)	2.05(1.29-3.25)*	1.22(0.71-2.09)
< Once a day	54(7.0)	722(93.0)	1.00	1.00
Consumption of Milk & derivatives				
> Once a day	11(21.6)	40(78.4)	3.25(1.60-6.58)*	2.64(1.14-6.13)*
≤ Once a day	76(7.8)	897(92.2)	1.00	1.00
Consumption of Meat, Egg & Fish				
> Once a day	17(21.8)	61(78.2)	3.49(1.93-6.29)*	1.93(0.94-3.96)
≤ Once a day	70(7.4)	876(92.6)	1.00	1.00
Consumption of Sweet & Sugars				
> Once a day	12(10.6)	101(89.4)	1.32(0.69-2.52)	
≤ Once a day	75(8.2)	836(91.8)	1.00	
Consumption of Fat				
> Once a week	3(5.1)	56(94.9)	0.56(0.17-1.83)	
≤ Once a week	84(8.7)	881(91.3)	1.00	
Physical activity pattern				
Time spent on TV, Computer & Video				
> 120 min/day	52(10.8)	431(89.2)	1.74(1.11-2.73)*	1.24(0.76-2.02)
≤ 120 min/day	35(6.5)	506(93.5)	1.00	1.00
Transport				
Car	57(11.5)	440(88.5)	2.15(1.35-3.40)*	1.20(0.69-2.08)
Foot/Bicycle	30(5.7)	497(94.3)	1.00	1.00
Hours of sleep				
> 9 hours	16(6.4)	235(93.6)	0.67(0.38-1.18)	
≤ 9 hours	71(9.2)	702(90.8)	1.00	
Physical activity				
Low	37(10.5)	317(89.5)	1.45(0.93-2.26)	
Moderate/high	50(7.5)	620(92.5)	1.00	

* = Statistically significant

3.4. Contextual Factors (Determinants) of Overweight/Obesity

Socio-demographic determinants: contextual factors of overweight/obesity are indicated in Table 5. Being a female was found to be a risk factor for overweight/obesity with COR=2.1 (95% CI; 1.3, 3.3). Adolescents in private schools were 3 times more likely to be overweight /obese, AOR=2.2(95% CI; 1.2, 4.2) compared with that of government schools. Fathers' and mothers' educational status (being above grade eight) was also a risk factor for overweight and obesity with COR=2.3(95%; 1.3, 3.9) and COR=2.2(95% CI; 1.4, 3.5) respectively. Bivariate analysis using logistic regression was done for age, religion, marital status, family size, occupational status of fathers' and mothers' of the respondents; and none of them were statistically associated with overweight/obesity.

Determinants related to eating Habit: less than three meals

per day AOR=1.9(95% CI; 1.1, 3.3), lacking daily breakfast AOR=2.4(95% CI; 1.4, 3.8), lacking daily dinner COR=3.2(95% CI; 2.1, 5.0) were statistically associated to overweight/obesity. Eating vegetables, fruits, milk and milk products and meat more than once a day were also analyzed and found statistically associated to overweight/obesity with [COR=1.7; 1.1, 2.8], [COR=2.1; 1.3, 3.3], [AOR=2.7; 1.1, 6.1] and [COR=3.5; 1.9, 6.3], respectively.

Determinants related to Physical Activity: Sedentary activity (watching TV, using the computer and playing videogames) for over 120 minutes increased odds of being overweight/obese almost by two fold [COR=1.8; 1.1, 2.7]. Using car as a means of transport from home to school and from school to home also increased the odds of being overweight/obese by two fold [COR=2.2; 1.4, 3.4]. Physical activity pattern (low, moderate and high physical activity) did not show statistically significant association with overweight/obesity.

4. Discussion

Nutritional status of adolescents: The mean height-for-age and BMI-for-age Z- score of the study populations were -0.72 SD and -0.48 SD, respectively. Although the mean BAZ and HAZ of the study subjects were better compared to rural communities of Tigray, they were below the reference curve compared to the WHO 2007 reference population [3]. The reason of scoring lower mean of BAZ and HAZ than the WHO growth reference might be due to their poor dieting habit which is not according to the recommended dietary intake. The prevalence of being under nutrition (stunting and underweight) among participants was 13.4% which is higher than that of adolescents in Palestine (4.8%) [17] and 8.7% reported from Jamaica [18] while it is much lower than that of adolescent girls from rural communities of Tigray (58.3%) [3], and Myanmar (32%) [19]. The prevalence of under nutrition in adolescents is terribly high compared to 4.8% reported in Palestine since under nutrition may affect the maturation and later physical work capacity.

4.1. Contextual Factors of Overweight/Obesity Related to Socio-Demographic Variables

The magnitude of overweight/obesity was 8.5 % (12.7% for private and 4.3% for government school students) which is comparable with that of Indian adolescents which ranged from (5.9–17.8%) [7] and Addis Ababa(8.5%) [14]. A similar study in Islamabad (14.1%) showed that overweight/obesity was higher compared to our study subjects [1]. Another study conducted in India showed a considerably lower percentage of obesity (2.2%) among adolescents [20]. Prevalence of overweight/obesity indicates remarkable difference between government and private schools in which overweight/obesity among private school students is comparable to studies from developed countries. One possible explanation for the higher percentage of overweight/obesity among private school might be due to their families' higher socioeconomic status in that it could have allowed them to adopt unhealthy nutritional habits including consumption of fast food, sweets and more animal products.

The prevalence of overweight/obesity in this study was higher among girls (11.3%) than boys (5.7%) OR=2.1 (955 CI; 1.3, 3.3). This finding contradicts the findings of Nigeria [21], Brazil [6], Canada [22] and Italy [23] which generally showed a higher prevalence of overweight/obesity among boys than girls. This high prevalence of overweight/obesity among girls is worrisome since overweight/obesity persists to adulthood and has an impact on psychosocial wellbeing of adolescents related to negative body image, low self esteem, and anxiety or depression, especially in girls [24,25]. Although fathers' and mothers' educational status above grade eight increases the odds of getting overweight/obesity by 2.4 times than family's educational status less than or equal to grade eight, this association was lost after controlling for the possible confounders.

4.2. Contextual Factors (Determinants) of Overweight/Obesity Related to Dietary Habit

In the crude analysis, the act of consuming fruits and green vegetables more than or equal to once per day in our study increased the odds of getting overweight/obesity with OR= 1.7 & 2.1 respectively. The result disagrees with the findings from Canada [22], Brazil [6] and Spain [26] showing that no fruit and greens consumption was associated with overweight and obesity. It also contradicts with the epidemiological studies that suggest consumption of a major quantity of fruits and vegetables is associated with a reduction of risk for cancer and is beneficial in cardiovascular diseases, diabetes, obesity and cerebral vascular accidents [27]. The reversed effect observed might be adolescents from wealthy families in the study population might tend to consume fruit and vegetables as a supplement in addition to the regular meal but not substitute the regular meal.

Eating animal product foods (milk, yogurt and cheese) more than once a day showed a significant association with overweight/obesity (AOR=2.6, 95% CI; 1.1, 6.1). This result is consistent with a study conducted among children and adolescents in elementary schools of Addis Ababa [14]. The fact behind this association might be animal product yields high energy that may lead to excess weight gain.

Lacking daily breakfast and having meals less than three times a day proved to be a risk factor for overweight/obesity (AOR= 2.3, 95% CI; 1.4, 3.8 and 1.9, 95% CI; 1.12, 3.28, respectively). This agrees with studies from Brazil [6] where the habit of no breakfasting daily was a risk factor for overweight and obesity; another study conducted elsewhere also showed that overweight children had breakfast less frequently than the thin ones [28]; and breakfasting regularly in the morning is associated to lower levels of cholesterol and to low weight [29, 30]. This study also agrees with another study from US in which frequent restrictive dieting contribute to slowed metabolic rate, binge eating and weight gain [31]. This might be true in that adolescents who are overweight/obese in this study were trying to control their weight by decreasing the number of meal omitting their

breakfast.

AOR: Adjusted for school type, sex, age, family educational status, meal frequency, frequency of breakfast and dinner, consumption of vegetables, consumption of milk products, consumption of animal products, time spent on TV, computer and video, means of transport and physical activity.

Determinants of overweight/obesity related to physical activity: Boys were more physically active than girls (P-value <0.01). This disparity of physical activity patterns between the sexes agrees with the reports from Palestine and US [15, 17]. The same trend was noticed for physical activity as boys are more physically active than girls. The study showed no association between the practice of physical activity and overweight/obesity. However, the tool used to evaluate this kind of activity was not specific for adolescents although it was validated in a population that included individuals aged from 12 years old [6].

The results of this assessment showed that the time spent watching TV, playing videogames and computers (>120 minutes/day) presented a significant association with overweight/obesity in crude analysis, losing significance in the multivariate analysis. Other studies performed in Brazil [6] and England [15] agrees with this result. Some authors, however, do not consider the habit of watching TV, playing videogame or using the computer as markers for inactivity in the association between sedentarism and overweight [32]. The proportion of secondary school adolescents walking to school (49%), being driven to school (48.5%) and cycling to school (2.5%) was comparable to results from developed countries like England in which the proportion of walking, driven and cycling was 56%, 42% and 2% respectively [15]. Changes in patterns of physical activity and the adoption of more sedentary lifestyles are likely to be important factors behind overweight/obesity.

Conclusions and recommendations: Findings of the present study indicated that both under and over nutrition are important problems of adolescents in government and private secondary schools. Adolescents in private schools, sedentary lifestyle, lacking regular consumption of breakfast, eating meal less than 3 times per day, and consuming milk, yogurt and cheese more than once a day significantly influenced the overweight/obesity of adolescents. Hence, it is recommended that there should be targeted educational intervention programmes on sedentary activities, Health and nutrition. Furthermore, youth centers and schools should encourage opportunities for low/no cost physical activities.

Limitation of the study: Since the study was cross sectional study it was difficult to establish a direct cause and effect relationship between risk factors and outcome variable. During interview there might be social desirability bias by participants. The absence of qualitative methods is another limitation of this study.

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Abbreviations: AOR -Adjusted Odds Ratio; BMI-Body Mass Index; BAZ-BMI-for-Age Z-score, CI-Confidence Interval; COR-Crude Odds Ratio;FAO- Food and Agriculture Organization; FFQ-Food Frequency Questionnaire; HAZ-Height-for-Age Z-score; IPAQ-International Physical Activity Questionnaire; OR-Odds Ratio; USA-United States of America; WHO-World Health Organization.

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