Research Article　　　　　　　　　　　　　　　　　　　　　　　　　　　**Open Access**

Magnitude of Overweight/Obesity and Associated Factors among High School Adolescents' in Addis Ababa, Ethiopia

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Abstract

Background: Worldwide, at least 2.8 million peoples die each year due to overweight and obesity and an estimated 35.8 million (2.3%) of global Disability Adjusted Life Years (DALYs) are caused by overweight and obesity. Therefore this study aimed to measure to the magnitude of overweight/obesity and associated factors among high school adolescents' in Addis Ababa.

Methods: Cross-sectional study design was conducted from February, 2016 to March, 2016 among high school adolescents' in Addis Ababa, Ethiopia. Data were entered in to Epi Info version 7 and exported to SPSS version 20 software for analysis. Multiple logistic analyses were done to control possible confounding variable. P-value less than 0.05 were taken as significant association.

Result: The prevalence of adolescents' overweight and obesity was 18.2%.Family income [AOR= 4.1(95% CI; 1.1, 15.8)], physical activity [AOR= 2.7(95% CI; 1.0, 6.9)], sleep duration [AOR=3.7(95% CI; 1.9- 7.0, p=0.000)] had significant association with overweight and obesity.

Conclusion: Higher prevalence rates of overweight and obesity were seen. Family income, physical activity and sleep duration were important determinants impacting the risk of overweight/obesity in adolescents. Strategies which focus on collaboration among health sectors and education sectors, increasing awareness on adolescent adequate duration of sleep at night through mass media and training for parents at school level should be given to encourage their children to involve themselves in more physical exercises, sports and outdoor activities. Schools should also facilitate the environment for sport grounds.

Keywords: Overweight; Obesity; Adolescent; Short sleep duration

Abbreviations: BMI: Body Mass Index; CDC: Center for Disease Control and Prevention; DALY: Disability Adjusted Life Year; EDHS: Ethiopian Demographic Health Survey; Kcal: Kilo-Calorie; Kg: Kilo Gram; NSF: National Sleep Foundation; WHO: World Health Organization.

Background

Worldwide, at least 2.8 million peoples die each year due to overweight and obesity and an estimated 35.8 million (2.3%) of global Disability Adjusted Life Years (DALYs) are caused by overweight and obesity [1].

In the past, overweight and obesity were problems of high-income countries; however, now days it is dramatically on the rise in low- and middle-income countries, particularly in urban setting [1,2]. Adolescence, particularly teenagers age (13-19) is a critical period for the development of overweight and obesity that transit into adulthood [3-5].

Overweight is defined as Body Mass Index (BMI) for ages greater than or equal to 85th percentile and less than 95th percentile, and Obesity is defined as BMI for ages greater than or equal to 95th percentile [4].

In recent decades, prevalence of children's overweight and obesity increased worldwide from 4.2% in 1990 to 6.7% in 2010, and this trend is expected to reach 9.1% in 2020. These findings are particularly alarming since children's obesity is strongly associated with a wide range of serious health complications and increased risk of premature illness and death later in life [6].

The main cause of overweight and obesity is an energy imbalance between calories used and calories expended [4,7]. Several factors contribute toward the occurrence of overweight and obesity in adolescents. Globally there has been an increased intake of energy-dense food that are high in fat, sugar, salt and an increase in physical inactivity due to increasing sedentary nature of many forms of activities, changing modes of transportation and increasing urbanization [4,8]. However, in recent years, short sleep duration has received greater attention as independent risk factor for overweight and obesity in adolescents [9,10].

Many cross-sectional and longitudinal studies in developed countries have shown short sleep duration could increase energy intake by increasing hunger, giving people more time to eat and promoting people to choose less health diets; and could decrease energy expenditure by decreasing physical activity and lowering body temperature [11-13]. Recently there is convincing evidence that getting a less than ideal amount of sleep is independent and strong risk factor for overweight and obesity in infants and children as well as in adults [11].

In Africa, despite a high prevalence of under nutrition, the prevalence of overweight and obesity is increasing at an alarming rate. It is estimated that 4% to 7% of urban children are overweight [4,12,13]. Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, hypertension, stroke and cancer [14]. Since adolescents are still vulnerable to develop overweight and obesity, early control is necessary at this stage of life, in order to avoid an unfavorable long-term prognosis, as in adulthood. Future complications of this condition in adulthood can be serious if early intervention measures are not established [15].

Currently there is a growing pattern of adolescents overweight and obesity in Ethiopia especially in urban areas. WHO estimated in 2008 in Ethiopia, the prevalence death due to overweight and obesity was 7.4% and 1.1%, respectively [5].

In Ethiopia, different studies showed that overweight and obesity are caused due to increased intake of energy-dense food, physical inactivity, changing modes of transportation and increasing urbanization. However, there is no published article showing that short sleep duration is an independent risk factor to cause overweight and obesity for adolescents in the country. Ethiopian Demographic Health Survey (EDHS) 2011 reported the burden of adulthood overweight and obesity, but still there is scarce research report on adolescents' overweight and obesity. In the study area, though it is common to see overweight people in all age groups, including school adolescents, there is no research report done to assess the association between sleep duration and overweight/obesity of adolescents. Therefore this study aimed to measure the magnitude of overweight /obesity and associated factors among high school students.

Methods and Materials

Study area

Cross-sectional study design was conducted from February to March, 2016 among high school adolescents' in Addis Ababa, Ethiopia. Addis Ababa is the capital city of Ethiopia with a great diversity, and homes of almost all ethnicities are found in the country. The city contains 10 administrative sub cities namely: Arada, Yeka, Gulele, Addis Ketema, Akaki Kality, Nefassilk Lafto, Lideta, Bole, Kolfe Keranio, and Kirkos. According to the 2015/2016 report of Addis Ababa City Government Educational Bureau, there are 171 high schools. In all these schools, there are a total of 127,056 students. From the total number of schools, 62.57% are private and 37.43% are public.

Populations

Adolescents age between 13-19 in Addis Ababa enrolled from grade 9-12 for the 2015/2016 academic years who were attending their regular classes were included.

Sample size determination

The required sample size was determined by using single population proportion formula by taking 13.9% of expected prevalence overweight and obesity [5], assuming 5% margin of error and 95% confidence level, design effect of 2 and 10% for non-response rate. The calculated sample size was 405.

Sampling technique and procedures

Stratified multi stage sampling procedure was employed to select the study units. In the city there are 107 private and 64 public high schools. Four private and two public with a total of six high schools were selected by simple random sampling. The total sample size was allocated for each selected high schools proportionally to the number of students within each school. Finally, study participants were selected by systematic sampling method from a student list of each section.

Data collection tools and procedures

Data associated with socio-demographic variables, dietary information, eating habit, physical activity, sedentary activity, sleep duration information and anthropometric measurements were collected using self-administered questionnaire adapted from. Trained health professionals took anthropometric measurements and anthropometric measurement of weight was taken to the nearest 0.1 kg using calibrated digital balance in standing position, and heights were measured to the nearest 0.5 cm using height measuring board in standing position after students removed their heavy clothing and shoes.

Data analysis procedures

Data were coded, cleaned and entered to EPI-INFO version 7 and were exported to SPSS version 20 for analysis. Body mass index (BMI) was computed using weight and height (Kg/m^2). Descriptive statistics using frequencies, proportion and table were used to present the study results. Binary logistic regression analysis was employed to see association between short sleep duration and overweight/obesity. To evaluate the association between short sleep duration and overweight/ obesity, both crude odds ratio (COR) and adjusted odds ratio (AOR) with 95% confidence interval were computed. P-value less than 0.05 was taken as significant association.

Results

Socio-demographic characteristics

A total of 390 participants were involved with a response rate of 96.3%. Of the three hundred ninety participants 168 (43.08%) were males and 222 (56.92%) were females, among these 165 (42.30%) were between the age of 13-16 and 225 (57.70%) in the age group 17-19. About two hundred fifty four (65.13%) participants were from public schools and 136 (34.87%) were from private schools.

Variables	Level	Frequency	Percent (%)
Type of school	Public	254	65.13
	Private	136	34.87
Sex	Male	168	43.08
	Female	222	56.92
Age (in years)	13-16	165	42.3
	17-19	225	57.7
Grade level	9	108	27.7
	10	101	25.9
	11	88	22.6
	12	93	23.8
Father's educational status	Illiterate	14	3.59
	Read and write	46	11.79
	Elementary	42	10.77
	High school	103	26.41
	Higher education	185	47.44
Mother's educational status	Illiterate	25	6.41
	Read and write	49	12.56
	Elementary	61	15.64
	High school	136	34.87
	Higher education	119	30.52
Father's occupation	Daily laborer	18	4.62
	Private organization employee	161	41.28
	Business person	71	18.21
	Government employee	91	23.33
	Unemployed	1	0.26
Mother's occupation	Daily laborer	4	1.03
	Private organization employee	87	22.31
	Business women	51	13.08
	Government employee	71	18.21
	House wife	154	39.49
Household monthly income (in ETB)	<=1864	46	11.8
	1865-7368	190	48.7
	7369-22727	127	32.6
	>22727	27	6.9

Table 1: Socio demographic characteristics (n=390) among high school adolescents in Addis Ababa, 2016.

Regarding educational status of parents, one hundred eighty five (47.44%) completed higher education; whereas 60 (15.38%) of fathers had no formal education. On the other hand, mothers who attended high school were 136 (34.87%); while 74 (18.97%) of the mothers had no formal education. As to major occupation of fathers and mothers, 161 (41.28%) were private employees and 154 (39.49%) were housewives, respectively. Of all, forty six (11.8%) of the respondents' family earned 1864 ETB or less, and 27 (6.9%) of the families earned more than 22727 birr per month (Table 1).

Dietary habits and meal pattern

Dietary habit of the participants showed that seventeen (4.36%) of the respondents did not consume fruit, while 50 (12.82%) ate once per day. Fifteen (3.85%) of adolescents never consumed vegetables, while 182 (46.67%) ate two to four times per week and 31 (7.95%) ate once per day. On the other hand, twenty three (5.9%) of the participants responded that they did not consume meat and egg, 114 (29.23%) consume meat and egg two to four times per week and 34 (8.72%) consume once per day. About sixteen (4.10%) of participants did not eat sweet food, whereas 95 (24.36%) ate once per day (Table 2).

Variable	Level	Frequency	Percent (%)
Fruits intake	Never	17	4.36
	Less than once a week	80	20.51
	Once a week	99	25.38
	Two to four times per week	132	33.85
	Once per day	50	12.82
	More than twice per day	12	3.08
Vegetables intake	Never	15	3.85
	Less than once a week	54	13.85
	Once a week	97	24.87
	Two to four times per week	182	46.67
	Once per day	31	7.95
	More than twice per day	11	2.82
Bread and cereals intake	Never	3	0.77
	Less than once a week	14	3.59
	Once a week	18	4.62
	Two to four times per week	104	26.67
	Once per day	115	29.49
	More than twice per day	136	34.87
Meat and eggs intake	Never	23	5.9
	Less than once a week	100	25.64
	Once a week	99	25.38
	Two to four times per week	114	29.23
	Once per day	34	8.72
	More than twice per day	20	5.13
Milk, cheese and yogurt intake	Never	67	17.18
	Less than once a week	107	27.44
	Once a week	94	24.1

	Two to four times per week	60	15.38
	Once per day	49	12.56
	More than twice per day	13	3.33
	Never	16	4.1
	Less than once a week	38	9.74
	Once a week	55	14.1
	Two to four times per week	90	23.08
	Once per day	95	24.36
Sugar and sweets intake	More than twice per day	96	24.62

Table 2: Dietary habits (n=390) among high school adolescents in Addis Ababa, 2016.

Frequency of meal pattern attended by participants showed that one hundred eighty one (46.41%) ate meal three times per day, while 42 (10.77%) ate less than three times in a day. From the total sampled respondents, two hundred seventy nine (71.54%) took breakfast daily, 98 (25.13%) took breakfast sometimes and 13 (3.33%) never took breakfast at all.

Variable	Level	Frequency	Percent (%)
	<1 meal a day	1	0.26
	1 meal a day	9	2.31
	2 meals a day	33	8.46
	3 meals a day	181	46.41
Number of meals per day	>3 meals a day	166	42.56
	Daily	279	71.54
	Sometimes	98	25.13
Breakfast	Never	13	3.33
	Daily	309	79.23
	Sometimes	70	17.95
Lunch	Never	11	2.82
	Daily	278	71.28
	Sometimes	102	26.15
Dinner	Never	10	2.56
	Daily	75	19.23
	Sometimes	277	71.03
Fast food	Never	38	9.74
	Daily	8	2.05
	Sometimes	207	53.08
Visible fat in meat	Never	175	44.87

Table 3: Meal pattern of the adolescent students(n=390) among high school adolescents in Addis Ababa, 2016.

The majority, three hundred nine (79.23%) took lunch daily and 70 (17.95%) took lunch sometimes, while 11 (2.82%) never took lunch. Two hundred seventy eight (71.28%) took dinner regularly, 102 (26.15%) took dinner sometimes and 10 (2.56%) never took dinner. Fast food and visible fat in meat was taken frequently by two hundred seventy seven (71.03%) and 207 (53.08%) of the participants (Table 3).

Physical activity and sedentary lifestyle

The participants physical activity status related to sport and recreation revealed that three hundred thirty eight (86.7%) did not participate in vigorous physical exercise, causing a major increase in heart beat rate and respiration, while 52 (13.3%) of the respondents did vigorous physical exercise. The majority three hundred forty one (87.4%) did not engage in moderate physical exercise that cause minor increase in heart rate and respiration, whereas 49 (12.6%) did moderate physical exercise (Figure 2).

Sedentary behavior of the respondents showed that two hundred forty six (63.1%) of the adolescents go to and come from school on foot and 144 (36.9%) travelled by car. About two hundred seventy four(70.3%) of the respondents spent with watching TV programs, playing video games or browsing the Internet less than 120 minutes a day, while 116 (29.7%) spent 120 minutes and more a day (Table 4).

Variables	Level	Frequency	Percent (%)
Vigorous exercise	Yes	52	13.3
	No	338	86.7
Moderate exercise	Yes	49	12.6
	No	341	87.4
Mode of transportation to/from school	Walking	246	63.1
	Car	144	36.9
Time spent watching TV programs and playing video games or browsing the Internet	<120minutes a day	274	70.3
	>=120minutes a day	116	29.7

Table 4: Physical activity and sedentary lifestyle characteristics (n=390) among high school adolescents in Addis Ababa, 2016.
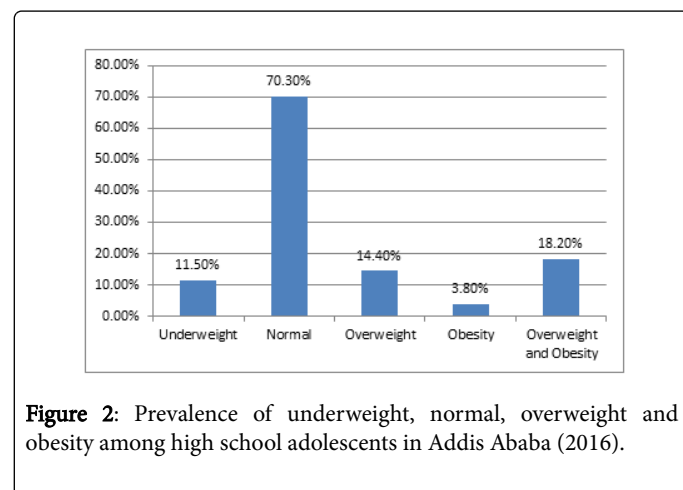
Sleep duration

The overall prevalence of short, normal and long sleep duration was 165 (42.3%), 170 (43.6%) and 55 (14.1%), respectively (Figure1).
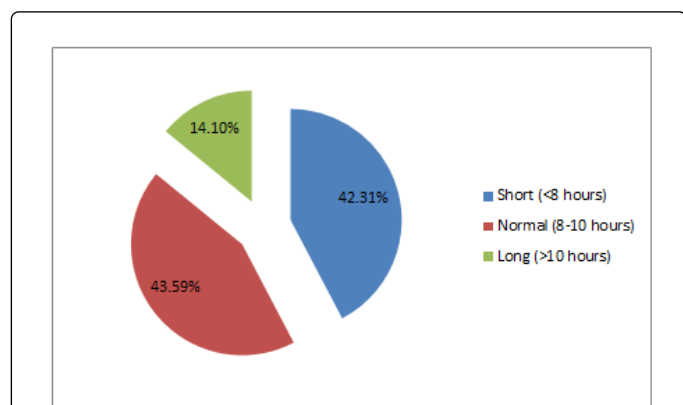
Figure 1: Prevalence of sleep duration among high school adolescents in Addis Ababa (2016).

Figure 2: Prevalence of underweight, normal, overweight and obesity among high school adolescents in Addis Ababa (2016).

Prevalence of overweight and obesity

The prevalence of overweight and obesity in the study participants were 14.4% and 3.8%, respectively. The combined prevalence of overweight and obesity was 18.2% (Figure2).

Determinants of overweight/obesity

Potential confounders, such as age, sex, household monthly income, dietary habit, physical activity and sedentary lifestyle in relation to sleep duration and overweight/obesity were analyzed using binary logistic regression.

In the binary logistic regression analysis, overweight/obesity was significantly associated with household monthly income of more than 22727 ETB [COR=7.6(95% CI; 2.3, 25.2)], did not engage in vigorous or moderate exercise [COR=2.4(95% CI; 1.1, 5.6], did not eat lunch daily [COR=0.4(95% CI; 0.2, 0.9)] and short sleep duration [COR=3.4(95% CI; 1.9, 6.0)].

However, there was no statistically significant association observed between overweight/obesity and variables such as sex, age, time spent on (TV, video games or internet), meal pattern, frequency for breakfast, and dinner, and daily frequency of consumption for fruits, vegetables, cereals, fats, sugars, fast foods, milk and milk products and meat. The possible reason that diet did not significantly associated with overweight/obesity might be due to non-variation of eating habit among the respondents.

Finally, using multiple binary regression model, analysis was done to control for potentially confounding variables. As indicated in Table 7, only household monthly income, physical activity and sleep duration were the independent determinants for overweight/obesity.

From the household monthly income group, adolescents whose family's income more than 22727 ETB per month were 4.1 times more likely to be overweight/obese, AOR=4.1(95% CI; 1.1, 15.8) compared with those family's income less or equal to 1864 ETB per month. Adolescents whose family's earn 1865-7368 and 7369-22727 ETB per month, respectively, were statistically not significant when compared to those families earning less or equal to 1864 ETB per month. Doing physical exercise was found to protect overweight/obesity. Those adolescents who did not do vigorous or moderate exercise were 2.7 times at risk than those who did [AOR=2.7(95% CI; 1.0, 6.9)].

When insignificant variables were adjusted, the result with sleep duration was slightly increased. Adolescents sleeping short sleep duration (<8 hours/day) were 3.7 times more likely to develop overweight/obesity, AOR=3.7(95% CI; 1.9, 7.0) than those who sleep normal (8-10 hours/day). Long sleep duration did not show statistically significant association with overweight/obesity (Tables 5-7).

Sleep duration	Frequency	Percent (%)
Short (<8 hours)	165	42.31
Normal (8-10 hours)	170	43.59
Long (>10 hours)	55	14.1

Table 5: Prevalence of sleep duration among high school adolescents in Addis Ababa (2016).

Body Mass Index	Frequency	Percent (%)
Underweight	45	11.5
Normal	274	70.3
Overweight	56	14.4
Obesity	15	3.8

Table 6: Prevalence of underweight, normal, overweight and obesity among high school adolescents in Addis Ababa (2016).

Variables			Overweight/obesity		COR (95% CI)	AOR (95% CI)
			Yes	No		
			n(%)	n(%)		
Sex	Male		32 (8.2)	136(34.9)	1	1
	Female	39(10.0)	183(46.9)	0.91 (0.54-1.52)	0.64 (0.34-1.20)	
Age	13-16		30(7.7)	135(34.6)	1	1
	17-19	41(10.5)	184(47.2)	1.00 (0.59-1.69)	0.97 (0.52-1.82)	
Monthly income (in ETB)	<=1864		5(1.3)	41(10.5)	1	1
	1865-7368	22(5.6)	168(43.1)	1.07 (0.38-3.01)	0.63 (0.21-1.91)	
	7369-22727	31(7.9)	96(24.6)	2.65 (0.96-7.29)	1.59 (0.52-4.88)	
	>22727	13(3.3)	14(3.6)	7.61 (2.3-25.19)	4.11 (1.08-15.76)*	
Fruits intake	<once a day		59(15.1)	269(69.0)	1	1
	>=once a day	12(3.1)	50(12.8)	1.09 (0.55-2.18)	0.86 (0.37-2.00)	
Vegetables intake	<once a day		63(16.1)	285(73.0)	1	1
	>=once a day	8(2.1)	34(8.7)	1.06 (0.47-2.41)	1.13 (0.44-2.95)	
Cereals intake	<once a day		26(6.7)	113(29.0)	1	1
	>=once a day	45(11.5)	206(52.8)	0.95 (0.56-1.62)	1.23 (0.65-2.35)	

Meat & eggs intake	<once a day		56(14.3)	280(71.8)	1	1
	>=once a day	15(3.8)	39(10.0)	1.92 (0.99-3.72)	1.31 (0.56-3.09)
Milk, cheeses & yogurt	<once a day		58(14.8)	270(69.3)	1	1
	>=once a day	13(3.3)	49(12.6)	1.24 (0.63-2.42)	1.10 (0.48-2.50)
Sweet & sugars intake	<once a day		34(8.7)	165(42.3)	1	1
	>=once a day	37(9.5)	154(39.5)	1.17 (0.69-1.95)	1.15 (0.63-2.10)
Meals per day	<3 meals/day		5(1.3)	38(9.7)	1	1
	3 meals/day	40(10.3)	141(36.2)	2.16 (0.79-5.84)	1.89 (0.61-5.92)
	>3 meals/day	26(6.7)	140(35.9)	1.41 (0.51-3.92)	1.07 (0.31-3.75)
Frequency of breakfast	Daily		45(11.5)	234(60.0)	1	1
	Not daily	26(6.7)	85(21.8)	1.59 (0.92-2.74)	1.57 (0.80-3.07)
Frequency of lunch	Daily		63(16.2)	246(63.1)	1	1
	Not daily	8(2.1)	73(18.7)	0.43(0.19-0.93)*	0.42 (0.17-1.02)
Frequency of dinner	Daily		44(11.3)	234(60.0)	1	1
	Not daily	27(6.9)	85(21.8)	1.69 (0.99-2.89)	1.62 (0.83-3.16)
Consumption of fast food	Daily		13(3.3)	62(15.9)	1	1
	Not daily	58(14.9)	257(65.9)	1.08 (0.56-2.09)	1.23 (0.55-2.77)
Consumption of fat	Daily		2(0.5)	6(1.5)	1	1
	Not daily	69(17.7)	313(80.3)	0.66 (0.13-3.35)	0.54 (0.07-3.92)
Physical activity pattern					
Vigorous or moderate exercise	Yes		7(1.8)	67(17.2)	1	1
	No		64(16.4)	252(64.6)	2.43 (1.07-5.55)	2.66 (1.03-6.90)*
Time spent on TV, video games or internet	<120 minutes/day		45(11.5)	229(58.7)	1	1
	>=120minutes/day		26(6.7)	90(23.1)	1.47 (0.86-2.53)	1.49 (0.79-2.81)
Sleep duration	Normal		19(4.9)	151(38.7)	1	1
	Short		49(12.6)	116(29.7)	3.36 (1.88-6.01)	3.69 (1.94-7.04)*
	Long		3(0.8)	52(13.3)	0.46 (0.13-1.61)	0.51 (0.14-1.89)

Table 7: Binary logistic regression analysis of determinants of overweight/obesity among high school adolescents in Addis Ababa (2016).

Discussion

Prevalence of overweight and obesity

The overall magnitude of overweight and obesity among adolescents in Addis Ababa was 18.2%, of which 14.4% accounted for overweight and 3.8% accounted for obesity. This prevalence was congruent with studies in urban communities of Hawassa and Bahir Dar, which was 15.6% (14) and 16.7% (16), respectively. However, it was higher than the finding of study done in Ghana (7) and Addis Ababa (5), which was 13.0% and 13.9%, respectively. This could be explained by change in the lifestyle factors of the society through time.

Determinants of overweight/obesity

Using the World Bank income classification of 2015, household monthly income was statistically significant association with overweight and obesity. Adolescents from families income more than 22727 ETB per month were 4.1 times more likely to be overweight/obese as compared with adolescent whose family income was less or

equal to 1864 ETB per month [AOR=4.1(95% CI; 1.1, 15.8)]. This finding was consistent with the result from Egypt where the prevalence of overweight and obesity significantly higher among the adolescents of high income compared with those of low income [16,17]. Similarly, study conducted in Hawassa showed that adolescents from higher income were 7.19 times more likely to develop overweight/obesity when compared with adolescent whose family was from low income, AOR=7.19(95% CI; 2.6, 19.89) [14].

In addition, study conducted in Bahir Dar showed significant association between household income and overweight/obesity, where from higher family income were more likely to be overweight/obese than from low-income family (16). This might be related to the patterns of high energy expenditure from low income, where engaging in any work besides learning contributes to reducing the prevalence of overweight and obesity.

Physical activity was another independent predictor that is statistically associated with overweight/obesity. Adolescents who did not do any vigorous or moderate exercise for at least ten minutes were 2.7 times at risk of being overweight/obese than those who did vigorous or moderate exercise [AOR= 2.7(95% CI; 1.0, 6.9)]. This result was in line with studies conducted in Gondar and Addis Ababa which also showed that lack of physical activity had positive association with overweight and obesity [2,5]. A similar report from Pakistan revealed that lack of physical activity was found to be significantly associated with overweight in adolescents [18]. Another study in China also indicated that regular physical activity was an important factor in reducing the prevalence of overweight and obesity [19]. The possible reason for this result might be due to lower energy expenditure caused by decreased vigorous/moderate physical exercise.

In both crude and adjusted binary logistic regression, sleep duration was strongly associated with overweight/obesity. The present study showed that there was the involvement of adolescents with insufficient sleep according to the minimum recommendation (8 hours/day) [20]. Such behaviors are due to increase in social, hormonal changes and use of caffeine or stimulants [21], and can lead to a serious damage to health and quality of life as well as the emergence and worsening of diseases, overweight/obesity being the focus of the present study. This study also showed that students having short duration of sleep (<8 hours/day) were 3.7 times more likely to develop overweight/obesity [AOR=3.7(95% CI; 1.9- 7.0, p=0.000)] than those who sleep normal (8-10 hours/day). This finding was in line with result from South Korea, where reduced sleep duration among adolescents was strongly associated with a greater risk for overweight/obesity, P<0.0001 [22]. Supporting result from Saudi Arabia revealed that sleeping short duration significantly increased the risk of being obese among adolescents [23]. Similar report from Italy showed that short sleep duration was significantly associated with obesity for school children [24].

Another study conducted in Japan also indicated that students with short sleep were 2.87 times more likely to be obese than normal sleepers [25]. In addition, a consistent finding from Taiwan showed short sleep duration had positive association with overweight and obesity [26-28]. One possible explanation for higher prevalence of overweight/obesity among short sleep duration of adolescents might be due to staying long at night with academic reading. Findings in this study should be interpreted in light of inherent limitations of the study. The cross sectional design which precludes inferences of causal associations. The use of self-reported rather than objectively measured physical activity and sedentary lifestyle likely to have been subjected to recall bias and measurement errors.

Conclusion

Findings of this study revealed that higher prevalence rates of overweight and obesity were seen among high school adolescents of Addis Ababa city. Having short sleep duration was strongly associated with overweight/obesity in adolescents. Physical inactivity and coming from high-income families were also important determinants impacting the risk of overweight/obesity in adolescents.

Based on the observed findings, it is suggested that there should be collaboration among health sectors and education sectors of Addis Ababa to reduce problems of adolescent overweight/obesity. Increasing awareness on adolescent adequate duration of sleep at night through mass-media should also be considered as important preventive program. Training should be given at school for parents to encourage their children to involve themselves in more physical exercises, sports and outdoor activities. Schools should also facilitate the environment for sport grounds.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from research ethical committee of Addis Ababa University, School of Public Health. Letter of permission was obtained from Education Departments of Sub-cities and Directors of Schools to be studied. Informed verbal consent was obtained from each study subjects and their parents after the data collectors clearly explained the aims of the study.

Consent to publish

Not applicable

Availability of data and materials

Data is not available for online access, however readers who wish to gain access to the data can write to the corresponding author.

Competing Interest

We declared no financial, personal or professional competing interests influenced this paper.

Authors Contributions

EA was involved in **conception, designing the study,** writing proposal, analysis, and interpretation of data. TY was involved in analysis and interpretation of data and manuscript writing. All authors agreed to be accountable for all aspects of the work.

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