



**ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE
DEPARTMENT OF PUBLIC HEALTH**

**MAGNITUDE AND PREDICTORS OF HIGH BODY MASS INDEX
AMONG HIGH**

**SCHOOL STUDENTS IN GULELE SUBCITY ADDIS ABABA, ETHIOPIA:
SCHOOL BASED CROSS-SECTIONAL STUDY**

**A RESEARCH PAPER TO BE SUBMITTED TO DEPARTMENT OF
PUBLIC HEALTH, SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL
COLLEGE IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR
THE DEGREE OF DOCTOR OF MEDICINE (MD).**

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LIST OF ABBREVIATIONS

AACAEB- Addis Ababa City Administration Education Bureau

BMI – Body Mass Index

CI – Confidence Interval

CVD- Cardiovascular Diseases

DM- Diabetes Mellitus

IOTF- International Obesity Task Force

NCD- Non Communicable Diseases

SPSS- Statistical Package for Social Sciences

SSA - Sub Saharan Africa

USA - United State of America

WHO- World Health Organization

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List of Tables

Table 1: Socio-demographic characteristics of high school students in Gulele subcity, Addis Ababa, 2018

Table 2: Eating habits of high school students in Gulele subcity, Addis Ababa, 2018

Table 3: Physical activities of high school students in Gulele subcity, Addis Ababa, 2018

Table 4: Medical Condition of high school students in Gulele subcity, Addis Ababa, 2018

Table 5: The association between selected predictor variables and overweight and obesity among high school students in Gulele subcity, Addis Ababa, Ethiopia 2018.

High BMI magnitude and predictors

Summary

Background-high body mass index (BMI) which includes overweight and obesity is a risk factor for diet-related non communicable diseases. These diseases are the fifth leading risks for global deaths. Virtually, all age groups are affected from consequences of overweight and obesity. The problem still needs further investigation to obtain base line data that enable to undertake appropriate and effective measures that are directed towards improving BMI of high school students.

Objective – To determine magnitude and predictors of high BMI in high school students in Addis Ababa, Ethiopia

Method - A school based cross sectional study design was implemented and data was gathered using pre designed questionnaire adopted from other similar studies. And the data was analyzed using SPSS and the results were presented using graphs, tables and figures.

Results: Among 499 participants, the magnitudes of overweight and obesity were 11.3% and 1.6%, respectively, and the combined prevalence of overweight and obesity together was 13%. Three-fourths of the respondents (71.5%) had healthy body mass index; however, 15.4% were underweight. school type, having pocket money, not doing vigorous activity, frequency of doing vigorous physical activity and having first degree relative who is overweight or obese were statically significant predictors of overweight and obesity among high school students.

Conclusion and recommendation: The problems of overweight and obesity are taking place while students are still under the risk of underweight. Several factors were correlated with overweight and obesity. Therefore, interventions targeting physical activities, frequency of doing physical activity and school environment are recommended.

High BMI magnitude and predictors

Contents

1. INTRODUCTION	1
1.1 Background.....	1
1.2 statement of the problem.....	2
1.3 significance of the study.....	3
2.0 LITERATURE REVIEW.....	4
3. OBJECTIVES	6
3.1. General Objective:	6
3.2. Specific Objective:.....	6
4. METHODS AND MATERIAL	7
4.1. Study area.....	7
4.2. Study design	7
4.3. Population.....	7
4.3.1 Source population	7
4.3.2. Study population.....	7
4.4.1. Inclusion criteria.....	8
4.4.2. Exclusion criteria	8
4.5. Sample Size Determination And Sampling Technique	8
4.5.1. Sample size determination	8
4.5.2. Sampling technique and sampling procedure	9
4.6. Data collection.....	10
4.7. Study variables.....	10
4.7.1. Dependent variable	10
4.7.2. Independent variable	10
4.8. Operational definition	11
4.9. Data processing and analysis.....	11
4.10 .Ethical consideration.....	11
4.11. Dissemination of Findings.....	12
5.0 RESULTS.....	13
5.1.Sociodemographic Characteristics.....	13

High BMI magnitude and predictors

5.2. Eating Habits of participants.....	15
5.3. Physical Activities of participants.....	16
5.4. Medical Condition of Participants.....	17
5.5. Magnitude of High BMI.....	18
5.6. Factors associated with High BMI.....	19
6.0.DISCUSSION.....	20
7.0 CONCLUSION AND RECOMMENDATION.....	22
8.0 REFERENCES.....	23
9.0 ANNEXES.....	26

1. INTRODUCTION

1.1 Background

Body Mass Index (BMI) is a measure of weight in relation to height. It is the most practical way to estimate if a person is underweight, at a healthy weight, overweight, or obese [1]. Measuring body mass index (BMI) is the first step to determine the degree of adiposity. The BMI is easy to measure, reliable, and correlated with percentage of body fat and body fat mass. In addition, it is used for identifying adults at increased risk for morbidity and mortality due to being overweight and obese. BMI is calculated from the weight and square of the height as follows: [2,3].

$$\text{BMI} = \text{body weight (in kg)} \div \text{height (in meters)}^2$$

- Underweight — BMI <18.5 kg/m²
- Normal weight — BMI ≥18.5 to 24.9 kg/m²
- Overweight — BMI ≥25.0 to 29.9 kg/m²
- Obesity — BMI ≥30 kg/m²

High BMI (Overweight and obesity) are excessive fat accumulations in the body which are linked to serious diet-related non communicable diseases that affect human health [4]. Globally, obesity is more than twice folded since 1980; more than 1.5 billion adults were overweight and obese. Overweight and obesity are the fifth leading risks for global deaths and are major contributors to the leading killer diseases worldwide, including diabetes, heart disease, and some cancers [5].

The prevalence of obesity is increasing so rapidly in all age groups in most countries that the World health organization (WHO) has defined it as an epidemic and a serious public health burden in Western countries [6]. The prevalence of high BMI is increasing worldwide and developing countries are beginning to experience this trend [7]. Nearly, all age groups and socioeconomic classes of the population are affected by the consequences of overweight and obesity [8].

High BMI magnitude and predictors

Adolescents are also one of vulnerable groups to overweight and obesity that could result in premature deaths and disabilities in adulthood. In addition to increased future risks, obese children experience breathing difficulties, increased risk of fractures, hypertension, and early markers of cardiovascular disease [4,9,10].

1.2. Statement of the problem

Low and middle income countries are now facing a double burden of nutritional problems, while they are continuing to deal with under-nutrition and are also experiencing a rapid up surge of non-communicable disease risk factors such as obesity and overweight [5, 11]. The magnitude as well as the severity of overweight and obesity specifically in adolescents is also increasing at an alarming rate that makes it one of the most serious health problems which affects this age group[12]

Analysis of trend data among 188 countries shows 2.1 billion people which accounts for nearly 30% or two third of the world's population are either overweight or obese. The rise in global obesity rates over the last three decades has been substantial and widespread, presenting a major public health epidemic in both the developed and the developing world. Currently almost 2/3rd of the world's obese people live in developing countries and increases are likely to continue unlike developed countries in which the increase began in the 1980s, accelerated from 1992 to 2002 and have slowed since 2006 [13].

We can see that obesity is largely been determined by modifiable life style factors such as unhealthy dietary behavior, low physical activity and sedentary behavior and also environmental factors. So that in Developed countries it is increasingly being recognized that system based multi-level intervention approaches that address both individual and environmental factors should be considered. Interventions that only focus on specific individual, social or environmental factors could not be much effective [14].

The traditional concerns of governments and policy-makers have focused on under-nutrition, with greater emphasis being placed on the continuing problem of childhood protein–energy malnutrition. It is now common to find under-nutrition and obesity existing side-by-side within the same country, the same community, and the same household.

High BMI magnitude and predictors

Ethiopia is one of the developing countries in which overweight and obesity is increasing and high school students are among the commonly affected age groups. It is also becoming one of the major causes of morbidity and mortality. In developing countries, like Ethiopia, much attention is given to under nutrition rather than over nutrition. The government and policy makers are not in line with prevalence of the problem. Nowadays diet related non communicable diseases becoming common causes of morbidity and mortality in Ethiopia.

1.3. Significance of the study

Despite being an emerging public health issue there is no adequate researches done in Ethiopia especially on high-school students. Therefore it is important to do this study to provide the current information about the magnitude of the problem and to assess the prevalence of the problem so that better strategies can be devised in improving the impending problems associated with it.

The results of this study could be used for policy makers and relevant stakeholders to design and implement an effective prevention and control strategies and programs that could address factors of overweight and obesity.

2. LITERATURE REVIEW

Globally, there is rising prevalence of overweight and obesity in both developing and developed Countries[1]. The rate of obesity has tripled in developing countries over the past 20 years as they rapidly become more urbanized, with increased consumption of high calorie foods and adoption of a more sedentary lifestyle [15,16]

In the late 1800s in the United States, only 3% of adults were considered overweight and obese, whereas approximately 34% of adults are obese today. However, obesity is also a common problem among children and adolescents in addition to adults. Within the past 20 years, the incidence of overweight children has doubled and the number of overweight adolescents has tripled [17]. In 2012, an estimated 62% of adults (aged 16 years and over) were overweight or obese in England (BMI ≥ 25), 24.7% were obese (BMI ≥ 30) and 2.4% were severely obese (BMI ≥ 40)[18].

The prevalence of childhood and adolescent overweight and obesity is also increasing in most other developed countries worldwide. It is difficult to directly compare prevalence rates between countries because of differences in definitions and dates of measurements. Use of the International Obesity Task Force (IOTF) standards typically results in lower prevalence estimates than other standards [19,20]. However, studies using comparable statistics show that rates are particularly high (greater than 30 percent) in most countries in North and South America, as well as in Great Britain, Greece, Italy, Malta, Portugal, and Spain [21]

There are somewhat lower rates in the Nordic countries, and the central portion of Western Europe. In Russia and most of the countries of Eastern Europe the prevalence of overweight is lower (less than 10 percent), but increasing. In China, the prevalence of overweight among children is approximately 1/3 of that in the US, but a greater proportion of pre-school-aged children are affected [20].

A systematic review conducted among sub Sub-Saharan African countries on a total of 283 articles revealed the trend towards increasing proportions of overweight/obesity over time in school-aged children while there was a persistent problem of underweight. For the entire time period, weighted averages of overweight/obesity and obesity were 10.6% and 2.5% respectively [22]

High BMI magnitude and predictors

In Bahirdar, North West Ethiopia a school based cross sectional study was done in high school students among 431 students in 2015 found that the magnitudes of overweight and obesity were 12.3% and 4.4%, respectively, and the combined prevalence of overweight and obesity together was 16.7%. Three-fourths of the respondents (74.7%) had healthy body mass index; however, 8.6% were underweight. Sex, frequency of eating food out of home, school type, family monthly income, family having vehicle, vigorous physical activity, and frequency of vigorous physical activity were statistically significant predictors of overweight and obesity [23]

An institution-based cross-sectional study was conducted in February and March 2014 in Addis Ababa on randomly selected high school adolescents showed that the prevalence of overweight, obesity and overall overweight/obesity was 9.7%(95% CI=6.9-12.4%), 4.2% (95% CI=2.3-6%), and 13.9% (95%CI= 10.6-17.1%) with female sex, learning in private school and being in the higher wealth category the associated factors.[24]

Another School -based comparative cross-sectional study was conducted among Adolescents 10-19 years old in Addis Ababa with a total of 20 private schools were included in the study in which 10 were with adequate space and the rest 10 without adequate space for physical activity. The study found that The overall magnitude of overweight & obesity among the study participants was 17.0% which was significantly higher in schools without adequate space for physical activity (19.4% versus 14.6%) with p-value of 0.01[25]

3. OBJECTIVES

3.1. General Objective:

- To assess the magnitude and predictors of high BMI among high school students in Addis Ababa, Ethiopia

3.2. Specific Objective:

- To determine the magnitude of high BMI (overweight and obesity) among high school students
- To identify associated factors for high BMI

4. METHODS AND MATERIAL

4.1. Study area

The study was conducted in Addis Ababa, the capital city and also the largest city in Ethiopia which covers 530.14 square kilometers. Addis Ababa is found with an altitude of 2300 meters and is located at 901'48"N with subtropical highland climate. The city has three layers of administration: city government, 10 sub cities and 116 woreda administrations. The City is the commercial and cultural hub of the country functioning as the seat of the African Union and the Ethiopian Federal Government. The city administration is divided into ten sub-cities: Addis Ketema, Akaki-Kality, Arada, Bole, Gulele, Kirkos, Kolife, Lideta, Nifas Silk-Lafto, and Yeka sub-cities. Gulele sub-city is located on the northern part of the city administration and covers 30.18 square kilometers. It's divided into 10 weredas and has a total population of 267,381 (Addis Ababa central statistics agency). There are 15 high schools: 6 public and 9 private in Gulele Sub-city. The total number of students in the high schools is 13,871 among which 6222 are females and 7649 are males.

4.2. Study design

An institution based cross sectional study design was implemented self-administered questionnaires in selected schools.

4.3. Population

4.3.1 Source population

All high school students of the Gulele Sub-city

4.3.2. Study population

Randomly selected high-school students of the selected high schools in Gulele Sub-city

4.4. Eligibility criteria

4.4.1. Inclusion criteria

Age group between 15 and 24 years

Those present during the time of study

4.4.2. Exclusion criteria

Unwilling to give consent for the study

Pregnancy during data collection

Visible physical deformity

4.5. Sample Size Determination And Sampling Technique

4.5.1. Sample size determination

Captivating a single population formula and prevalence from previous similar study done in Addis Ababa which is 13.9%, sample size was calculated as follows

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

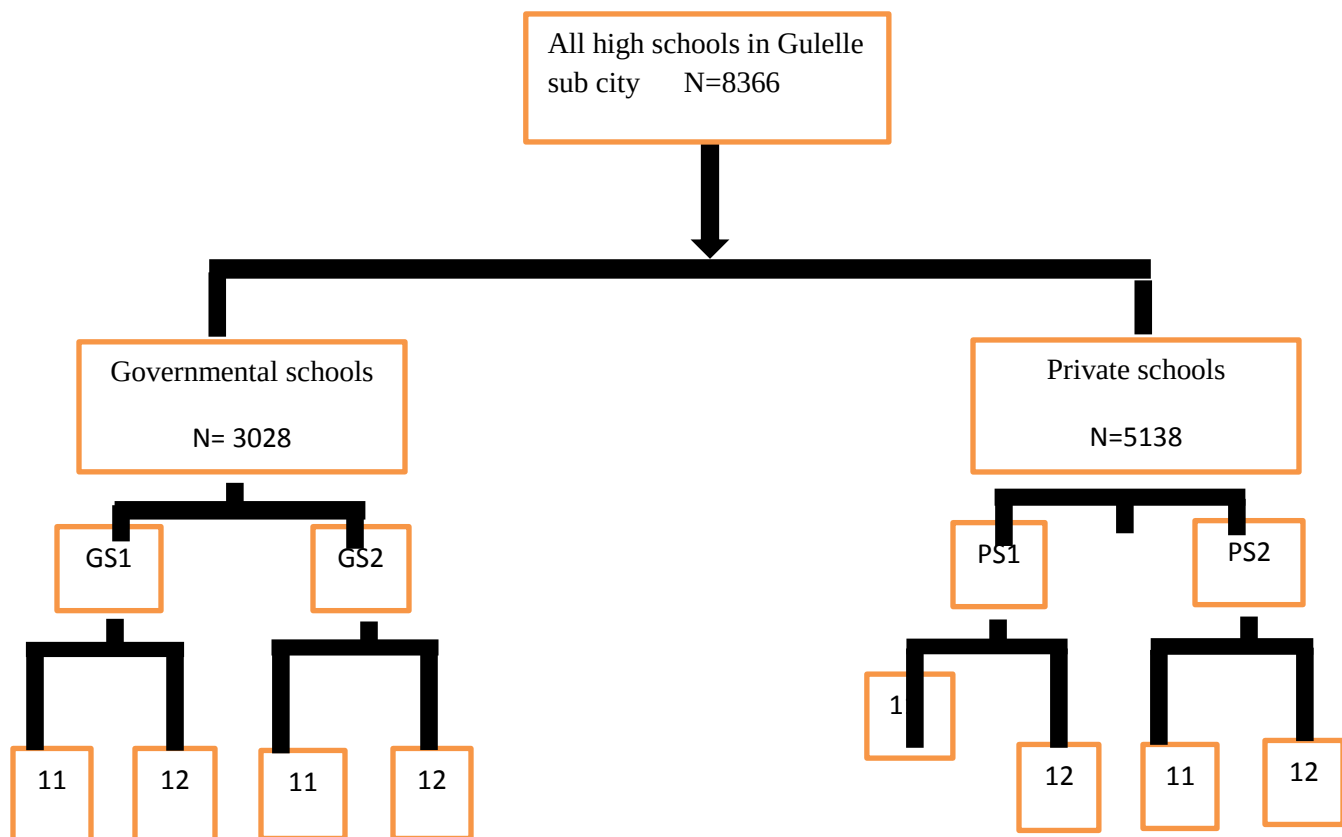
Taking CI = 95%

W= 0.05

The sample size is 536

4.5.2. Sampling technique and sampling procedure

We employed a multi-stage sampling technique. First, the schools were stratified into public and private schools. Among the list of the public and private high schools, Proportionally 2 public and 2 private high schools were randomly selected.



4.6. Data collection

We prepared a self-administered structured questionnaire in English by adapting it from the Global School-Based Student Health Survey (GSHS). The questionnaire have socio-demographic variables, ten modules (on alcohol use; dietary behaviors; drug use; hygiene; mental health; physical activity; protective factors; sexual behaviors that contribute to HIV infection, other STIs, and unintended pregnancy; tobacco use; and violence and unintentional injury) and factors. We have recruited two final year medical students as data collectors and train them for two days on the objective of the study, the data collection, data quality and the whole process of the field work. The research team oriented the study participants on the study tool after school time is completed and the questionnaires were administered by the students at the school.

We also conducted anthropometric assessment of the students. The weight and height of the students were taken at the schools immediately after they administered the questionnaires.

4.7. Study variables

4.7.1. Dependent variable

- Body Mass Index

4.7.2. Independent variable

- age

- Sex

- Religion

- Ethnicity

- School type

- Family income

- Family size

- Dietary condition

- Physical activity

4.8. Operational definition

High MBI...BMI greater than or equal to 25kg/m²

Overweight BMI ≥ 25.0 to 29.9 kg/m²

Obesity Obesity – BMI ≥ 30 kg/m²

Moderate exercise...low-impact aerobic exercise classes such as brisk walking, recreational team Sports (volley ball, soccer)

Vigorous exercise...Running or jogging, high-intensity aerobic classes, competitive full-field Sports

4.9. Data processing and analysis

To ensure data quality, the research assistants and data collectors have got training. Supervisors checked the completeness, consistency and appropriateness of the collected data every day and completed or corrected according to the identified problems. Data cleaning, organizing, transforming and summarizing were done once the data entered into SPSS.

The collected data from the pre-coded questionnaires entered, cleaned, summarized and analyzed using Statistical Package for Social Sciences (SPSS) 20 version software. Descriptive statistics used to summarize some key variables (including socio-demographic) by calculating percentages, mean, median, mode, standard deviation, quartiles and range. Bivariate analysis was done using cross tabulations, χ^2 test and binary logistic regression to look for associations between a single independent variable and the dependent variable (high BMI).

4.10. Ethical consideration

The proposal was submitted to St. Paul's Hospital Millennium Medical College (SPHMMC) Institutional Review Board (IRB) for ethical clearance. Having secured the ethical clearance, the IRB approval and SPHMMC's support letters were submitted to Addis Ababa City Administration Education Bureau (AACAEB). The AACAEB wrote an official permission and support letter to Gulele sub-city education office and the respective schools. The data collection has started after official permission was secured from the respective schools.

High BMI magnitude and predictors

For the study participants, we requested informed voluntary assent without any pressure from the study team or their parents after explaining the purpose, processes, potential risks, and potential benefits of the study as well as their right to refuse to participate in the study or to withdraw at any time during the process of the study. They were given opportunity to ask any question and to keep the contact information of the principal investigator if they would like to ask any question or further information related with the study.

4.11. Dissemination of findings

Once the research is concluded, it will be presented to SPHMMC community and the final report will be submitted to SPHMMC Department of Public Health and Addis Ababa City Administration Education Bureau. It will also be presented in international and local relevant events as oral or poster presentation. It will also be sent to peer-reviewed journals for publication.

5. RESULTS

5.1. Socio demographic characteristics of the participants

A total of 536 students completed the questionnaire; of these 37 responses were excluded because of gross incompleteness; the remaining 499 were included in the analysis with response rate of 93%. Out of the 499 participants 267 (53.5%) were male. Majority of the participants were at the age of 18 (222, 44.5%) and 17 (179, 35.9%) with a median age of 18. Majority of the participants, 285 (57.1%) were grade 11 and the remaining were grade 12 students. Most of them, 284 (56.9%) were natural science students. Regarding the religious distribution 213 (42.7%) were orthodox, 143 (28.7%) Muslim, 114 (22.8%) Protestant, 5 (1%) catholic and the others group accounts to 23 (4.6%) of the participants. Ethnically most of them were Amhara (199, 39.9%) and Oromo (104, 20.8%), the others were Gurage (12.2%), Tigray (7.6%) and others (19.4%).

Table 1: Socio-demographic characteristics (N=499) of High School Students in Gulele subcity, Addis Ababa, 2018 (N=499)

Variables	Categories	Frequencies	Percentages
Sex	Male	267	53.5
	Female	232	46.5
Age in Years	16	13	2.6
	17	179	35.9
	18	222	44.5
	19	67	13.4
	20	17	3.4
	21	1	0.2
Grade Level of Participant	11th grader	285	57.1
	12th grader	214	42.9
Field of study	Natural science	284	56.9
	Social sciences	215	43.1
	above my expectation	52	10.4

High BMI magnitude and predictors

	below my expectation	329	65.9
Religion	Orthodox	213	42.7
	Muslim	143	28.7
	Protestant	114	22.8
	Catholic	5	1
	Others	23	4.6
Ethnic group of the participant	Oromo	104	20.8
	Amhara	199	39.9
	Tigray	38	7.6
	Gurage	61	12.2
	Other	97	19.4
	Rural	44	8.8
Education Status of the mother/guardian	Illiterate	45	9.1
	Can read and write	78	15.7
	<=8th grade	88	17.7
	9 to 12th grade	148	29.8
	Diploma	50	10.1
	First degree	51	10.3
	>=second degree	36	7.2
Education Status of the father/guardian	Illiterate	31	6.8
	Can read and write	59	12.9
	<=8th grade	53	11.6
	9 to 12th grade	129	28.3
	Diploma	59	12.9
	First degree	80	17.5
	>=second degree	45	9.9
Employment status of mother/guardian	House wife	209	42.5
	Farmer	20	4.1
	Government Employee	90	18.3
	Private Firm employee	63	12.8

High BMI magnitude and predictors

	Own business	91	18.5
	Other	18	3.7
Employment status of father/guardian	Unemployed	23	5.1
	Farmer	27	6
	Government Employee	77	17.2
	Private Firm employee	103	23
	Own business	176	39.4
	Other	39	8.7
Marital status of parents of the participant	Married and living together	364	73.4
	Divorced/Separated	70	14.1
	Widowed	60	12.1

5.2. Eating Habits of High School Students in Gulele subcity, Addis Ababa, 2018.

The eating habit of the participants in this study, 77 (15.4%) of the respondents ate fruit more than Three days per week, 73% of the respondents ate fruits from one to three times per week, and the remaining 11.6% of respondents did not eat fruits at all. Out of the respondents who were reported to eat fruits, 227 (51.5%) reported to eat fruits one time per day, 189 (42.9%) reported to eat fruits two times per day, and the remaining 25 (5.6%) reported to eat fruits more than three times.

About 8(1.6%), 396(79.2%), and 96 (19.2%) of respondents reported to eat vegetables Zero, one to three, and more than three times per a week, respectively. Out of the respondents who reported to consume vegetables, 208 (42.4%), 235 (47.9%), and 48 (9.7%) consumed vegetables one time, two times, and three and more times, respectively, in their diet on the day they take vegetables.

Table 2: Eating habits of high school students in Gulele subcity, Addis Ababa

Variables	Categories	Frequency	Percentages
Number of days of fruit intake/week ($n = 499$)	Zero	58	11.6
	One to three times	364	73

High BMI magnitude and predictors

	More than three times	77	15.4
Number of times of fruit intake on the day fruit were taken (<i>n</i> = 441)	One	227	51.5
	Two	189	42.9
	Three and more times	25	5.6
Number of days of vegetables intake/week (<i>n</i> = 499)	Zero	8	1.6
	One to Three Times	396	79.2
	More than three times	96	19.2
Number of times of vegetables intake on the day fruit were taken (<i>n</i> = 491)	One	208	42.4
	Two	235	47.9
	Three and More times	48	9.7

5.3. Physical Activities of High School Students in Gulele subcity, Addis Ababa, 2018.

Regarding physical activities of students in Gulele subcity, the current study revealed that 235 (47.1%) of them were doing vigorous physical activity. Out of students who were doing vigorous activities, 78 (33.3%), 119 (50.9%), and 37 (15.8%) were doing vigorous activities one to three, four to six, and seven days per week, respectively.

Three hundred thirty-seven (67.5%) of students were doing moderate physical activities per week; 120 (35.7%), 174 (51.8%), and 42 (12.5%) of the students were doing moderate physical activities one to three, four to six, and seven days per week, respectively.

About 436 (87.4%) of the students reported to walk or use a bicycle for at least 10 minutes continuously to get to and from places. Of these students 38 (8.7%), 156 (35.7%) and 243 (55.6%) of them were doing it one to three, four to six, and seven days per week, respectively.

Table 3: Physical activities of high school students in Gulele subcity, Addis Ababa, 2018

Variables	Categories	Frequency	Percentage
Vigorous activity (<i>n</i> = 499)	YES	235	47.1
	NO	264	52.9
Number of days vigorous activity was done/week (<i>n</i> = 234)	1 to 3	78	33.3
	4 to 6	119	50.9

High BMI magnitude and predictors

	7 days	37	15.8
Moderate physical activity (<i>n</i> =499)	YES	337	67.5
	NO	162	32.5
Number of days moderate activities were done per week (<i>n</i> = 336)	1 to 3	120	35.7
	4 to 6	174	51.8
	7 days	42	12.5
Do you walk or use a bicycle for at least 10 minutes continuously to get to and from places? (N=499)	YES	436	87.4
	NO	63	12.6
on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places? (N=436)	1 to 3	38	8.7
	4 to 6	156	35.7
	7	243	55.6

5.4. Medical Condition of high school students in Gulele subcity, Addis Ababa

Regarding the Medical condition of the students 43 (8.6%) had their Blood glucose measured 20 (2.8%) had their blood pressure checked and told to have raised blood pressure by a health professional. And 16 (3.4%) had cholesterol measurement and told to have raised Cholesterol, 29 (5.8%) were checked for cardiac illness and told to have cardiac problem. Out of the students, 145 (29.1%) and 200 (40.1%) had history of First and Second Degree Family member who is typically overweight.

Table 4: Medical Condition of high school students in Gulele subcity, Addis Ababa, 2018

Variables	Categories	Frequency	Percentages
Have you ever been measured for blood glucose and told by a health professional that you have	YES	43	8.6
	NO	476	94.3

High BMI magnitude and predictors

raised blood sugar or diabetes mellitus?			
Have you ever been measured for blood pressure and told by a health professional that you have raised blood pressure?	YES	20	2.8
	NO	462	92.6
Have you ever been measured for blood cholesterol and told by a health professional that you have raised blood cholesterol?	YES	16	3.4
	NO	483	96.6
Have you ever been checked for any cardiac illness and told by a health professional that you have cardiac problem?	YES	17	2.7

8.5 Magnitude of Obesity and Overweight of high school students in Gulele subcity, Addis Ababa, 2018

The prevalence of high BMI was 13%, with prevalence of overweight and obesity being 11.4% and 1.6%, respectively among school adolescents (see Figure 2). Out of the total students involved in the study, proportion of students which showed normal body mass index were 71.5%, whereas 15.4% of high school students were underweight.

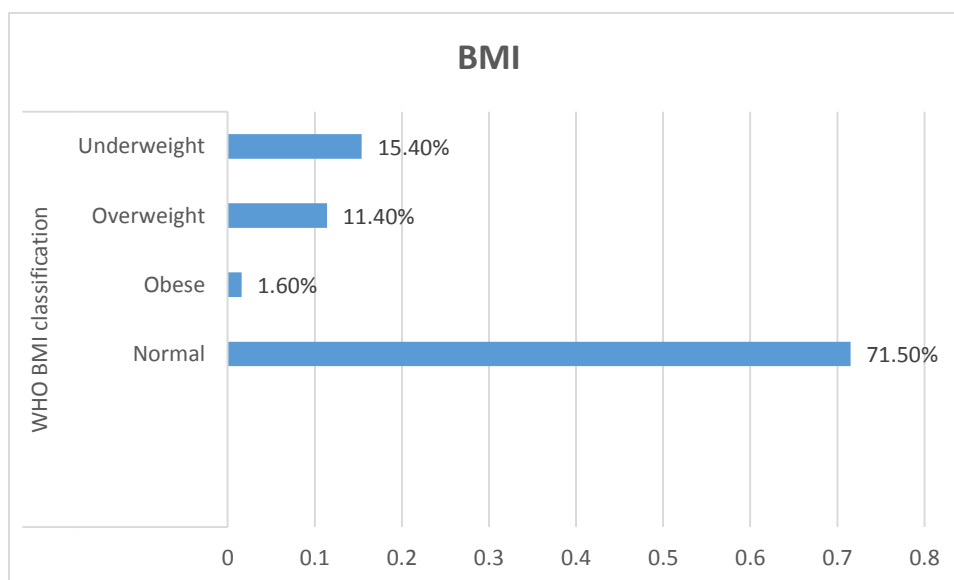


Figure 2: BMI of high school students in Gulele subcity, Addis Ababa 2018.

High BMI magnitude and predictors

8.6 Factors Associated with Overweight and Obesity among High School Students in Gulele subcity, Addis Ababa, Ethiopia, 2018

In the analysis of the study participants school type, having pocket money, not doing vigorous physical activity, frequency of doing vigorous physical activity, raised blood cholesterol and having first degree relative who is overweight or obese were statically significant predictors of overweight and obesity among high school students at *P*value of 0.05 levels.

Table 5: The association between selected predictor variables and overweight and obesity among high school students in Gulele subcity, Addis Ababa, Ethiopia 2018.

Variables	Categories	Overweight and Obesity (N= 499)		COR (95%CI for OR)	<i>P</i> value
		YES	NO		
Pocket Money	Yes	28	174	1	0.028
	NO	37	260	14.07 (1.326-149.36)	
Vigorous activity	Yes	26	209	0.71 (0.23-1.17)	0.01
	No	39	225		
Frequency of Vigorous physical activity/week	1 to 3 days	16	62	1.93 (1.44–6.34)	0.034
	4 to 6 days	9	110	1.12 (0.94-2.98)	
	7 days	1	36	1	
First Degree Obese Relative	Yes	42	103	9.2 (1.6-54.1)	0.014
	No	23	331	.	

6. DISCUSSION

According to the findings of this study the prevalence of overweight and obesity was 11.4% and 1.6%, respectively, resulting in the prevalence of overweight and obesity together, 13%. The magnitude of overweight and obesity in the current study was in accordance with a systematic review conducted among sub Sub-Saharan African countries on a total of 283 articles which revealed weighted averages of overweight/obesity and obesity were 10.6% and 2.5% respectively [22].

The findings of the current study on magnitude of overweight and obesity were in agreement with a study done in Nigeria among students, where the prevalence rates of overweight and obesity were 11.4% and 2.8%, respectively [26]; whereas our finding is not in accordance with other studies in Dar es Salaam Tanzania, where the prevalence of obesity was 19.2% [27]. It is also not in accordance with other studies in Pakistan, where the prevalence of overweight was 23% [28]. The reason for the variability may be attributed to different factors including the sociodemographic and economic inconsistency.

The results of this study were in accordance with a school based cross sectional study done in Bahirdar, North West Ethiopia among 431 students in 2015 which found that the magnitudes of overweight and obesity were 12.3% and 4.4%, respectively, and the combined prevalence of overweight and obesity together was 16.7% [23]. It is also in harmony with another study done in Addis Ababa on randomly selected high school adolescents which showed that the prevalence of overweight, obesity and overall overweight/obesity was 9.7%, 4.2%, and 13.9% [24].

Regarding the analytic component of this study, the odds of developing overweight and obesity among students who were attending private owned schools had higher risks of overweight and obesity compared to those in governmental schools. This was in line with other similar studies in different regions of our country, where adolescents learning in private schools reported to have higher risks of overweight and obesity [23,24,25].

This might be because adolescents in private schools usually come from families with higher socioeconomic groups which in turn might be exposed to high energy dense foods. In addition, a student from high economic classes usually uses vehicles for transportation. Moreover, adolescents in private school may also have less restriction on food and snack choices compared with those in public schools [25].

High BMI magnitude and predictors

The findings of this study also indicated that students having pocket money are at higher risk to be overweight and obese than those not having pocket money. This might be because students having pocket money are from family of high income group and may take high energy dense foods and might be doing less exercise and even use vehicles for transportation; this study also showed that adolescents from family having vehicle for transportation.

Furthermore, respondents who did not have vigorous physical activities were more than two times at higher risk to develop overweight and obesity compared to respondents who were doing vigorous physical activities. This might be because doing vigorous physical activities burns off body fat and is associated with less risk of overweight or obesity. This result is in line with other studies, where vigorous physical activities were associated with occurrence of overweight and obesity [23,24,25].

Additionally, frequency of doing vigorous physical activity was statistically associated with the occurrence of overweight and obesity. Respondents who were doing vigorous physical activity less frequently were more likely to report overweight and obesity compared to those who were doing it frequently; this is also supported by similar studies in Addis Ababa and Bahirdar done on adolescents [23,24].

Moreover, according to this study students having first degree overweight and obese relative were at higher risks than those who did not have. This is in accordance with similar studies Africa [26]. This can be explained by a scientifically enlightened hypothesis of some risks which can lead to overweight and obesity are genetically inherited [2].

7. CONCLUSION AND RECOMMENDATION

The prevalence of overweight and obesity among school adolescents was 11.4% and 1.6% respectively making the overall prevalence of overweight and obesity together 13%. Besides this, 71.5% of the participants found to have normal Body Mass Index and 15.4% of them found to be underweight.

Considering the results of this study factors such as school type, having pocket money, and doing vigorous activity, the frequency of doing vigorous activity and having overweight or obese first degree relative were independently correlated with overweight and obesity.

Moreover, physical activities should be promoted to engage students in physical exercises in order to prevent fat accumulation. Adolescents should be promoted to increase their physical activity level and walk to school rather than using private car.

Furthermore, high school adolescents should be screened for non-communicable diseases. Additionally those having an overweight or obese first degree relative should be screened regularly.

Hence, Education office of Addis Ababa City Administration, the respective schools, and the families need to collaborate to decrease the risks and improve the health status of the students.

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9. ANNEXES

Hello

My name is Dr. Nahom Girum a final year medical student (Intern) at Saint Paul's Hospital Millennium Medical College. I am conducting a research on "The magnitude and associated factors of high BMI (overweight/obesity) among high school students in Gullele sub city, Addis Ababa". I have received permission from the respected sub city education bureau to conduct this study.

You are selected to participate in this study because you are currently attending in one of the selected school for the study purpose. Your participation is purely based on your willingness. You have the right to choose not to take part in this study. If you choose to take part, you have the right to stop at any time. If you are willing to participate or refuse or decide to withdraw later, you will not be subjected to any ill-treatment.

If you agree to participate in the study, your weight and height will be measured using Standard measuring instruments. Only light clothes will be wearing during weight measurement and height will be measured with bare foot. You will fill a questionnaire about your dietary habit, physical activity and sedentary behavior and your school and home environmental factors that could be associated with overweight/obesity. The measurement and filling the questionnaire will take about 15 minutes.

The information that you provide will be kept confidential by using only code numbers and locking the data. Your name will not be written on the questionnaire. No one will have access to the non-coded data except the principal investigator and the data will not be used for purposes other than the study. Your willingness and active participation is very important for the success of this study.

Based on the understanding of the above information, are you willing to participate in this study?

A) Yes

B) No

Respondent (For both under and above 18 years old)

Signature _____ Date _____

High BMI magnitude and predictors

Date of Interview

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School Code

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Study Participant Code

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Data Collector Code

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Instruction: Please circle or write, as appropriate, your response(s) of the question after reading each question carefully (no correct or incorrect answer at all). If there is any question which is not clear, please ask the investigators/facilitators to help you.

Q #	Question	Code and Options	Skip Pattern/ Remark
Part I: Socio-demographic Data			
101	Age in completed years	_____	
102	Gender	1. Male 2. Sex	
103	Grade	1. 11 2. 12	
104	Field of study	1. Natural science 2. Social science	
105	School performance	1. 10 th grade result _____ 2. Average score of last semester _____ 3. Rank of last semester (_____/_____)	
106	How is your rank compared to your expectation?	1. Same as my expectation 2. Above my expectation 3. Below my expectation	
107	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Other (Specify) _____	
108	Ethnic Group	1. Oromo 2. Amhara 3. Tigray 4. Gurage 5. Other (specify)_____	

High BMI magnitude and predictors

Q #	Question	Code and Options	Skip Pattern/ Remark
109	Current family size (household members living currently in same dwelling unit)	Total Members Number of children	
110	Your birth order	_____	
111	Average monthly income of family (Could be in range)	1. _____ 2. I do not know 3. Unwilling to disclose	
112	Average monthly amount of money you get	_____	
113	Your source of money (multiple responses are possible)	1. My own 2. Father/Mother 3. Brother/Sister 4. Relatives 5. Other (specify) _____	
114	Education status of parents/guardians	Mother/Guardian 1. Illiterate 2. Can read and write 3. ≤ 8th Grade 4. 9-12 Grade 5. Diploma 6. First degree 7. ≥ Second degree Father/Guardian 1. Illiterate 2. Can read and write 3. ≤ 8th Grade 4. 9-12 Grade 5. Diploma 6. First degree 7. ≥ Second degree	
115	Employment status of parents/guardians	Mother /Guardian 1. House wife 2. Farmer 3. Gov't Employee 4. Private Firm Employee 5. Own Business 6. Other _____ Father/Guardian 1. Unemployed 2. Farmer 3. Gov't Employee 4. Private Firm Employee 5. Own Business 6. Other _____	
116	How is the marital status of your parents?	1. Married and living together 2. Divorced/separated 3. One parent deceased (Widowed)	
117	How is the parent/guardian-child relationship?	1. Authoritarian 2. Authoritative 3. Indulgent 4. Neglective	
Q #	Question	Code and Options	Skip Pattern/ Remark

High BMI magnitude and predictors

Q #	Question	Code and Options	Skip Pattern/ Remark
Part II: Body Mass Index Questions			
2.1. Diet Related Questions			
The next questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here that shows you some examples of local fruits and vegetables. Each picture represents the size of a serving. As you answer these questions please think of a typical week in the last year.			
201	In a typical week, on how many days do you eat fruit?	1.more than three times 2.one to three times 3.I don't eat fruits	
202	How many servings of fruit do you eat on one of those days?	1.one 2.two 3.three and more than three times	
203	In a typical week, on how many days do you eat vegetables?	1.more than three times 2.one to three times 3.I don't eat vegetables	
204	How many servings of vegetables do you eat on one of those days?	1.one 2.two 3.three and more than three times	
2.2. Physical Activity Related Questions			
<i>Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Think of work as the things that you have to do such as at school, paid or unpaid work, study/training, household chores ... In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.</i>			
206	Is there any school engagement (including physical education class) or any work (at home or out-of-home) or recreational activity (including sports) that involve vigorous-intensity activity that causes large increases in breathing or heart rate like carrying or lifting heavy loads, aerobics, push-up/pull-up and jumping rope for at least 10 minutes continuously?	1. Yes 2. No	
207	In a typical week, on how many days do you do vigorous-intensity activities at school?	1. 1 to 3 days 2. 4 to 6 days 3. 7 days	

High BMI magnitude and predictors

Q #	Question	Code and Options	Skip Pattern/ Remark
209	Is there any school engagement (including physical education class) or any work (at home or out-of-home) or recreational activity (including sports) that involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking or carrying light loads for at least 10 minutes continuously?	1. Yes 2. No	
210	In a typical week, on how many days do you do moderate-intensity activities as part of your regular exercise/home works?	1. 1 to 3 days 2. 4 to 6 days 3. 7 days	
<i>The next questions exclude the physical activities that you have already mentioned above. Now, I would like to ask you about the usual way you travel to and from places. For example, to school, to friends/relatives, for shopping, to place of worship.</i>			
212	Do you walk or use a bicycle for at least 10 minutes continuously to get to and from places?	1. Yes 2. No	
213	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	1. 1 to 3 days 2. 4 to 6 days 3. 7 days	
2.3. History of Non-Communicable Diseases Questions			
216	Have you ever been measured for blood glucose and told by a health professional that you have raised blood sugar or diabetes mellitus?	1. Yes 2. No	
217	Have you ever been measured for blood pressure and told by a health professional that you have raised blood pressure?	1. Yes 2. No	
218	Have you ever been measured for blood cholesterol and told by a health professional that you have raised blood cholesterol?	1. Yes 2. No	
219	Have you ever been checked for any cardiac illness and told by a health professional that you have cardiac problem?	1. Yes 2. No	
220	Is there any first-degree family member you know who is typically overweight?	1. Yes 2. No	Parents, Siblings, child (if any)
221	Is there any second-degree family member you know who is typically overweight?	1. Yes 2. No	Grandparents, aunts, uncles, nephew, niece

Anthropometric measurement

High BMI magnitude and predictors

No	Anthropometry	Reading
601	Weight (in kilogram)	
602	Height in (centimeter)	

Thank you in Advance!