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Prevalence and Determinant Factors of Overweight and Obesity among Preschool Children Living in Hawassa City, South Ethiopia

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Abstract
Background
Childhood obesity and its related adverse health effects have become major public health problems in developing countries. The prevalence of childhood obesity and overweight and their predictors are not well documented in the developing countries, especially in Ethiopia.
Objective
The objective of this study was to assess the prevalence and determinant factors of overweight and obesity among aged 3-5 years old children in Hawassa City, Ethiopia.
Methods
A cross-sectional survey was conducted in an urban locality called Hawassa City from February to March, 2012. Weight and height of the study children were measured and the dietary habits, physical activity and socio-demographic characteristics of the subjects were collected using a structured interview questionnaire. Logistic regression analyses were performed to identify predictors of obesity and overweight.
Results
Out of 358 participants, 50.6% were girls while 49.4% were boys with mean (±SD) age were 48.8±9 months. The combined prevalence of childhood obesity and overweight was 10.7%, the specific prevelences being 3.4% and 7.3% for obesity and overweight, respectively. Children living with higher socioeconomic status (SES) were significantly at risk for being overweight and obese as compared to children living with lower SES (AOR = 3.51 [95% CI: 1.30-9.50).
Conclusions
Although the prevalence of overweight and obesity among preschool children in the study area were lower than some reported elsewhere, its increase with socioeconomic status and food consumption practices in the study area indicates that it is an emerging problem given the rapidly increasing urbanization and changes in lifestyles and dietary habits. Overweight/obesity was more common among children with wealthier parents, early introduction of formula feeding, who ate a wide diversity of foods, consumed sweets and fast foods. Parents and children should be educated and trained on optimal nutrition practices.
Keywords: Preschool children, overweight, obesity, risk factors, Hawassa, Ethiopia

INTRODUCTION

Obesity is now well known as a medical problem among children. Outcomes associated with obesity in adults are now affecting children. The prevalence of overweight status has tripled worldwide in the last 2 to 3 decades, including in developing countries and regions that are increasingly urbanized (Lobstein, 2004). An international obesity task force (IOTF) analysis has shown that overweight and obesity affects one in 10 children worldwide, but the rate is double in Europe and three times as great across the entire Americas (IOTF, 2003).
Over nutrition is an emerging problem in segments of sub-Saharan African society, particularly where lifestyles become urbanized and westernized and data have accumulated on the adverse health effects of obesity in developed and developing nations. Non communicable diseases (NCDs) are imposing a growing burden up on developing countries which have limited resources and are still struggling to meet the challenges of existing infectious disease problems (WHO, 2004).
Increased risk for diabetes, dyslipidemia, coronary heart disease, atherosclerosis, hypertension, high blood cholesterol concentration, stroke, certain cancers and arthritis have been reported to be associated with childhood obesity (Vander *et al*., 2001). Obesity in childhood and adolescence has adverse consequences on premature mortality and physical morbidity in adulthood (Reilly & Kelly, 2011) and is associated with impaired health during childhood itself. Once obesity is established in children (as in adults) it is hard to reverse (de Onis & Lobstein, 2010).

In 2010, 43 million children (35 million in developing countries) were estimated to be overweight and obese; 92 million were at risk of overweight. The worldwide prevalence of childhood overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010. This trend is expected to reach 9.1%, or '60 million, in 2020. The estimated prevalence of childhood overweight and obesity in Africa in 2010 was 8.5% and is expected to reach 12.7% in 2020. The prevalence is lower in Asia than in Africa (4.9% in 2010), but the number of affected children (18 million) is higher in Asia (de Onis et al, 2010).

Modern dietary patterns and physical activity patterns are risk behaviors that travel across countries and are transferable from one population to another like an infectious disease, affecting disease patterns globally. While age, sex and genetic susceptibility are non-modifiable, many of the risks associated with age and sex are modifiable. Such risks include behavioral factors (e.g. diet, physical inactivity); biological factors (e.g. dyslipidemia, hypertension, overweight, hyperinsulinaemia) and finally societal factors which include a complex mixture of interacting socioeconomic, cultural and other environmental parameters (WHO, 2003). Furthermore, rapid changes in diets and lifestyles that have occurred with industrialization, urbanization, economic development and market globalization have accelerated over the past decade. This is having a significant impact on the health and nutritional status of populations, particularly in developing countries and in countries in transition. While standards of living have improved, food availability has expanded and become more diversified, and access to services has increased, there have also been significant negative consequences in terms of inappropriate dietary patterns, decreased physical activities and a corresponding increase in diet-related chronic diseases, especially among poor people (WHO, 2003).

In Ethiopia, many researchers were interested to study on undernutrition rather than overnutrition. Although, they continue to combat with the problems of undernutrition and infectious diseases but at the same time they are experiencing a rapid increase in risk factors of non-communicable diseases such as obesity, certain cancers, hypertension, diabetes and other coronary artery diseases particularly in urban settings like Hawassa City. The documentation of the extent of the problem and associated factors is critically important to prevent the problem and associated health consequences that could accrue throughout the life span. However, there were no studies regarding the prevalence of childhood obesity and overweight and its associated factors in Ethiopia in general and in Hawassa City in particular.

Published data regarding prevalence and detriment factors of overweight and obesity among preschool children aged 3–5 years in Ethiopia is limited. This study was therefore conducted to determine the level of childhood obesity and overweight in the study area and identify the most important dietary, physical activity pattern and socio-economic factors which have impact on obesity among preschool children aged 3-5 years in Hawassa city, Ethiopia. It is envisaged that data from this study will be useful for health policy makers, educators and other stakeholders in planning appropriate intervention programmes targeting preschool children.

METHODS

Study area, subjects and sample recruitment

This study was conducted in Hawassa City. It is located in the South part of Ethiopia with a total population of 258,808. The target population included 31,421 are under five children, of this 16,410 are girls and 15,011 are boys while the eligible source population of preschool children aged between 3-5 years is 17,425 (CSA, 2007). The data was collected from February 22 to March 22, 2012. In this community based cross-sectional study, 358 preschool children were selected by two stage cluster sampling method was used (probability proportional to population size and systematic random sampling) to select representative study subjects from the source population. The sample size was calculated by sample size determination formula for a single population proportion ($n= [(Z_{(1-\alpha/2)})^2 . p. (1-p)]/d^2$) with the following assumptions: 18% prevalence of overweight (Gewa, 2010), 95% confidence level, 5% degree of desired precision or margin of error for sampling, 2 design effect for cluster sampling error (de*n) and 5% non-response rate. Eligibility criteria were selected mothers who have permanent residence in the study area having apparently healthy children from 3-5 years old. An exclusion criterion was a child with evidence of physical impairment (such as physical defects or a grossly deformed), mental impairment and edematous conditions.

Data Collection Procedures

A structured interviews administered questionnaire was used to collect data related to the objectives of the study. The questionnaire on dietary habits and physical activities level were adapted from the WHO STEP wise approach to chronic disease risk factor surveillance (STEPS) (WHO, 2007). The questionnaire covered a range of topics including socio-economic and demographic factors, practices of breastfeeding and infant formula feeding of the child, semi-quantitative food frequency questionnaire in past one month, children's dietary diversity score (DDS) which report the different food groups consumed by children over the past 24 hours.

- **Socio-economic and demographic information**

Socio-economic and demographic information were collected by face-to-face interview of **children mothers**/caregivers which includes religion, ethnicity, educational status and occupation of the

mothers/caregivers; family size, wealth index, means of transportation, sex of child, age of child and educational status of child. **Wealth index information** on household assets was collected and included as follows: ownership of various durable goods (radio/tape, television, car, refrigerator, sofa, bicycle, motorcycle, mobile/telephone and others). **Wealth index** was ranked and divided into low, medium and high socio-economic status tertiles). A socio-economic status/**SES** index was constructed as an indicator of the level of wealth that is consistent with expenditure and income measures.

- **Assessment of feeding practices of the child**

The practices of breastfeeding and infant formula feeding of the child were assessed by face-to-face interview of mothers/caregivers.

- **Assessment of food frequency consumption**

It was adopted and assessed using semi-quantitative food frequency questionnaire for the period in past one month by face-to-face interview of mothers/caregivers (Gibson, 2005). Preschool children who eat **Fast Food means**: when eat more fat, eat more saturated fat, eat fewer fruits and vegetables in the past one month.

- **Assessment of dietary diversity score (DDS)**

Children's dietary diversity score was assessed by asking mothers/caregivers to report the different food groups consumed by children over the past 24 hours. The dietary diversity score (DDS) was rank divided in to three subgroups (tertiles): six & over (high), 3-5 (medium) and less than 3 (low) food groups consumed in the previous day. According to USAID (Swindale & Bilinsky, 2006) the following nutritional food groups were used to calculate DDS: (1) grains, roots and tubers, (2) vitamin A-rich fruits and vegetables, (3) other fruits and vegetables, (4) meat, poultry and fish, (5) eggs, (6) pulses, legumes and nuts, (7) milk and milk products and (8) foods cooked in oil/fat/butter and sweet drinks/foods**.**

- **Assessment of the physical activity level**

The global physical activity questionnaire (GPAQ) was used to assess the physical activity pattern among children 3-5 years old through face-to-face interview of mothers/caregivers in the study area. The GPAQ was developed by WHO for physical activity surveillance in developing countries like Ethiopia and the level of total physical activity is categorized as sedentary activity (low active), moderate activity and high activity (WHO, 2007). Among 16 questions, we excluded the work activity part since the study subjects were children 3 to 5 years old. We also checked the reliability of the questionnaire by using Cronbach's alpha scale test. Cronbach's alpha is **0.806**, which indicates a good level of internal consistency for our scale with this specific questionnaire.

- **Anthropometric measurements**

The measurements of height and weight were taken from each child using standardized and calibrated equipment. Height was measured children with barefoot and in light clothing: remove shoes, socks and bulky clothing (no pullover, shirt or coat) and undo the hair: remove any pins and braids from the hair that could affect the measurement. Height was recorded to the nearest 0.1cm and positioning the subject at the Frankfurt plane using a stadiometer seca (Germany). Weight was measured children with light clothing (underwear, t-shirt only) and weight was recorded to nearest 0.1 kg using UNICEF seca digital weighing scale (Germany) (Gibson, 2005).

Age was asked from both the child's date of birth and age on the day measured, since the year of birth is frequently reported incorrectly. If birth dates are not recorded or known with certainty, probe the mother/caregiver for the approximate date of birth based on a local events calendar. Then finally age was calculated using precise day by subtracting the date of birth from the date of data collection (WHO, 2009).

The z-score values for BMI-for-age (BAZ) of children from birth to 60 completed months were generated with WHO child growth standards using WHO Anthro 2009 program, version 3.2.2 (WHO, 2007a).

Overweight and obesity were operationally defined as the proportion of preschool children with values >2 SDs and >3 SDs, respectively, from the World Health Organization growth standard median. Being "at risk of overweight" was defined as the proportion with values >1 SD and ≤2 SDs, respectively (WHO, 2008).

Data quality control

Measurements of height and weight were taken in duplicate on each child. All the anthropometric measurements were taken by both investigator and trained diploma nurses to eliminate within-examiner error. Weight scale was calibrated to zero level with no object on it and placed in level surface before measurement was performed. Continuous checkup of scales was carried out for their reliability. The data collection was supervised by the principal investigator. The principal investigator supervised and reviewed every questionnaire for completeness and logical consistency and made corrections on the spot.

Statistical analyses

The data were checked for completeness, coded and entered in to a computer and then edited, cleaned, processed and analyzed using SPSS version 16.0. A one-sample Kolmogorov-Smirnov test was used to assess whether the data were normally distributed. Hosmer-Lemeshow test and Multicollinearity also checked. Those variables were not normally distributed and hence variables were transformed using log or square root transformation. Descriptive statistics (mean ± SD, frequencies, proportions and tables) were used. All tests were two sided and P-value < 0.05 was considered to be statistically significant. First bivariate regression analyses were done to

determine the association between the dependent variable and different predictors. Then multivariable logistic regression was carried out to isolate an independent effect of the predictors that showed significant association with obesity and overweight. To evaluate the association between obesity/overweight and predictor variables, both crude odds ratio (COR) and adjusted odds ratio (AOR) with 95% confidence interval were reported.

Ethical considerations

The study was reviewed and approved by the Institutional Review Board (IRB) of the University of Hawassa. Informed written consent was obtained from parents or caregivers. Child assent was taken for anthropometric measurements. Confidentiality of information collected from each study participant was maintained.

RESULTS

In this study, data were collected to determine the prevalence of overweight/obesity and a number of the risk factors that might be expected to affect overweight/obesity from a total sample of 358 mothers/caregivers and their 36-60 month old children, giving a response rate of 100%.

Socio-economic and demographic characteristics of the study participants

Regarding socio-demographic characteristics, 48.9% were Protestants and 31.6% were Orthodox by their religion, while the majority 36.0% was Sidama, followed by Wolaita (18.7%) by their ethnicity. About 31.3% of the mothers/caregivers completed 9-12 grade followed by 24.3% who were completed college or university level education and 8.1% of the mothers/caregivers had no formal education **(Table 1).**

The majority of respondents, 40.2% were housewives. The government employees, merchants and others accounted for 18.4%, 8.9% and 32.4%, respectively. The family size of the study participants ranged 2-16 with a median of 5 people per household. The majority of study participants had five or above and below five people per household accounting for 56.7% and 43.3%, respectively and majority (41.9%) of the study participants were from high socioeconomic status (SES) whereas 23.7% of the participants were categorized into low SES **(Table 1).**

The girls-boys ratio was 1.02 with 50.6% were girls and 49.4% were boys. Very large majority of the study subjects, 217 (60.6%), were under the age range of 48-60 months **(Table 1).**

Table 1. Socio-economic and demographic characteristics of mothers/caregivers and their children in Hawassa City, 2012 (n=358)

Variables		Frequency	Per cent (%)
Religion	Orthodox	113	31.6
	Protestant	175	48.9
	Muslim	61	17
	Others	9	2.5
Ethnicity	Sidama	129	36
	Wolaita	67	18.7
	Amhara	53	14.8
	Gurage	35	9.8
	Others	74	20.7
Educational status			
	Write and read only	29	8.1
	1-4 grade	58	16.2
	5-8 grade	72	20.1
	9-12 grade	112	31.3
	College/University	87	24.3
Occupation			
	House wife	144	40.2
	Government employee	66	18.4
	Merchant	32	8.9
	Others	116	32.4
Family size			
	<5	155	43.3
	≥ 5	203	56.7
SES tertiles			
	Low	85	23.7
	Medium	123	34.4
	High	150	41.9
Sex of child			
	Male	177	49.1
	Female	181	50.6
Age in months			
	36-47	141	39.4
	48-60	217	60.6

The mean (± SD) for age, height and weight were 48.8 (± 9) months, 101.9 (± 8.2) cm and 16.93 (±

2.98) kg, respectively. While the mean and standard deviations (± SD) of the BAZ score of children 3-5 years old based on WHO Anthro soft ware were analyzed as 0.6 and ±1.26

Prevalence of childhood overweight and obesity

The prevalence of overweight and obesity in the study participants were 7.3% and 3.4%, respectively. 25.1% of them were at risk-of-overweight in the study area based on BMI for age classification **(Table 2).**

The combined prevalence of overweight and obesity was 10.7%. The sex specific prevalence of overweight and obesity in boys were 9% and 3.4% while in girls were 5.5% and 3.3%, respectively **(Table 2).**

The age specific prevalence of overweight in age groups from 36-47 months was 12.1% and obesity was 4.3% while in age groups from 48-60 months, overweight was 4.1% and obesity was 2.8% **(Table 2).**

Table 2. Prevalence of childhood overweight and obesity by overall, sex and age groups among children 3-5 years old in Hawassa City, 2012 (n=358)

Variables	At risk of overweight	Overweight	Obese
	No. (%)	No. (%)	No. (%)
Overall	90 (25.1)	26 (7.3)	12 (3.4)
Sex			
Boys	56 (31.6)	16 (9)	6 (3.4)
Girls	34 (18.8)	10 (5.5)	6 (3.3)
Age (months)			
36-47	41 (29.1)	17 (12.1)	6 (4.3)
48-60	49 (22.6)	9 (4.1)	6 (2.8)

Feeding practices of the preschool children

Majority of the participants (98.9%) in this study were exclusive breastfed while 1.1% was not exclusive breastfed. Among exclusive breastfed children, majority (82.5%) was exclusive breastfed in the first six months while 10.5% was exclusive breastfed in the first four months and 7% was exclusive breastfed for more than six months after delivery. The majority of study participants (44.1%) were from 19-24 months, 27.7% were less than 12 months and 28.2% were from 12-18 months of continued breastfeeding within 24 months **(Table 3).**

About 68.7% fed infant formula while 31.3% were never fed on infant formula. The minimum and maximum age of start of infant formula was at one month and 12 months with a median of six months. The age of introduction of infant formula, for the majority (58.54%) of the children were later than six months and 38.21% was from 4 to 6 months while 3.25% were lower than or three months. The minimum duration of infant formula feeding was 2 months while the maximum was 30 months with a median of 12 months. The majority of children, 54.07% were fed with infant formula for more than or 12 months, 36.99% were fed between 4 to 11 months and 8.94% were lower than or three months duration of infant formula feeding **(Table 3).**

Table 3. Feeding practices of children 3-5 years old in Hawassa City, 2012 (n=358)

Variables	Frequency	Per cent (%)
Exclusive breastfeeding		
Yes	354	98.9
No	4	1.1
Duration of exclusive breastfeeding		
The first 4 months	37	10.5
The first 6 months	292	82.5
> 6 months	25	7.0
Duration of continued breastfeeding		
< 12 months	98	27.7
12-18 months	100	28.2
19-24 months	156	44.1
Infant formula feeding		
Given	246	68.7
Not given	112	31.3
Age of started infant formula		
0-3 months	8	3.25
4-6 months	94	38.21
> 6 months	144	58.54
Duration of infant formula		
0-3 months	22	8.94
4-11 months	91	36.99
≥ 12 months	133	54.07

Dietary diversity score by preschool children

The dietary diversity food groups reported by mothers/caregivers in the previous 24 hrs are presented in Table 5. In the study area, fruits are available in the market from March to May while vegetables are available in the market from December to February. The median intake of DDS was 6 and the mean (±SD) intake of dietary diversity score was 5.8 (±1.7) with 1 and 8 being the minimum and the maximum values, respectively. In this study, the majority of the study subjects (97.5%) of consumed foods from grain, root and tuber products, 68.2% ate foods from Vitamin A rich fruits and vegetables, 73.7% ate foods from other fruits and vegetables, 74% from eggs, 72.6% ate foods from meat, poultry & fish (MPF), 46.1% from legumes, nuts and pulses, 78.2% from milk and dairy products and 66.5% consumed from foods with oils /fats/ and sweet/soft drinks **(Table 4).**

Table 4. Proportion of children 3-5 years old who consumed different food groups in the last 24 hrs preceding the survey in Hawassa City, 2012 (n=358)

Food groups	Frequency	Per cent (%)
Foods made from grains, roots and tubers	349	97.5
Vitamin A-rich fruits and vegetables	244	68.2
Other fruits and vegetables	264	73.7
MPF*	260	72.6
Eggs	265	74
Food made from pulses, legumes and nuts	165	46.1
Milk and milk products	280	78.2
Miscellaneous (foods cooked with oil/fat or butter, sugars, honey, tea, soft drinks)	238	66.5
Children diet diversity score mean ± SD	**5.8 ± 1.7**	

MPF* = Meat, poultry and fish

Food consumption pattern by preschool children

Information regarding food consumption pattern of the children in the past one month prior to data collection are presented in table 6. Majority of the study participants (65.9 %) and 31.3% consumed cereal, grains and breads (pasta, macaroni, rice & injera) once per day or more and at least once per day, respectively. About 38% consumed roots and tubers based foods such as sweet potato, potato & carrot at least three to six times per week and about 41.1 % never consumed any enset and its products. About 52.5% and 38.3% consumed vegetables and fruits at least three to six times per week and at least once per day, respectively **(Table 5).**

The majority of the study participants (45.3%) consumed meat at least three to six times per week while 36.9% consumed eggs at least once per day. About 49.4% and 41.9% consumed milk & milk products more than once per day and at least once per day, respectively and majority (53.9%) of the participants never consumed fish. 56.7% consumed legumes in the form of 'Shiro Wot' which is traditional Ethiopian food made from peas and beans at least once per day **(Table 5).**

Some of the study participants, 20.4%, 29.6% and 32.7% consumed foods cooked with fat/ oil/butter at least once per day, at least three to six times per week and at least once or twice per week, respectively. About 47.2% consumed sweet foods and soft drinks at least once or twice per week and majority (79.9%) of the participants consumed tea with sugar at least once per day **(Table 5).**

Table 5. Food consumption pattern of children 3-5 years old in the past one month in Hawassa City, 2012 (n=358)

Frequency of food groups	More than once per day	Once per day	3-6 times per week	Once/twice per week	Twice per month/less	Never
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Cereals, grains & breads	236 (65.9)	112 (31.3)	5 (1.4)	5 (1.4)	-	-
Roots & tubers	10 (2.8)	100 (27.9)	136 (38)	84 (23.5)	23 (6.4)	5 (1.4)
Enset products	-	7 (2)	16 (4.5)	87 (24.3)	101 (28.2)	147 (41.1)
Vegetables	4 (1.1)	65 (18.2)	188 (52.5)	71 (19.8)	17 (4.7)	13 (3.6)
Fruits	11 (3.1)	137 (38.3)	137 (38.3)	55 (15.4)	18 (5)	-
Meat	5 (1.4)	39 (10.9)	162 (45.3)	121 (33.8)	25 (7)	6 (1.7)
Egg	25 (7)	132 (36.9)	113 (31.6)	64 (17.9)	16 (4.5)	8 (2.2)
Fish	-	3 (0.8)	6 (1.7)	48 (13.4)	108 (30.2)	193 (53.9)
Legumes	86 (24)	203 (56.7)	27 (7.5)	20 (5.6)	11 (3.1)	11 (3.1)
Milk & milk products	177 (49.4)	150 (41.9)	12 (3.4)	13 (3.6)	2 (0.6)	4 (1.1)
Food cooked with oil, fat or butter	41 (11.5)	73 (20.4)	106 (29.6)	117 (32.7)	19 (5.3)	2 (0.6)
Sweet foods & soft drinks	10 (2.8)	23 (6.4)	72 (20.1)	169 (47.2)	81 (22.6)	3 (0.8)
Tea with sugar	57 (15.9)	286 (79.9)	9 (2.5)	5 (1.4)	1 (0.3)	-

Determinant Factors of childhood obesity and overweight

Those introduced infant formula at age of four to six months were 5.1 times more likely to be obese/overweight as compared to those introduced infant formula later than six months (AOR=5.06 [95% CI: 2.09-8.33]) **(Table 6).**

Study participants who were categorized in the high socioeconomic status tertiles were 3.5 times more likely to be obese/overweight as compared to the low socioeconomic status tertiles (AOR = 3.51 [95% CI: 1.30-9.50]) **(Table 6).**

The prevalence of childhood obesity/overweight was higher proportion in age groups 36-47 months (16.4%) when compared to 48-60 months (6.9%). Children with age group 36-47 months were 4.6 times more likely to be obese/overweight when compared to children from age group 48-60 months (AOR = 4.59 [95% CI: 1.52-6.46]) **(Table 6).**

The odds of being obese/overweight for those who ate ice cream and sweet foods were 3.8 and 6.4 times more likely when compared to those who did not eat ice cream and sweet foods (AOR = 3.84 [95% CI: 1.62-7.09] and (AOR = 6.36 [95% CI: [1.88-12.33]), respectively **(Table 6).**

Consumption of fast foods by study participants was significant association with childhood obesity/overweight. Children who ate fast foods were 8.7 times found to be a higher risk for the development of obesity/overweight than their peers who did not eat fast foods (AOR = 8.69 [95% CI: 1.11-13.50]) **(Table 6).**

Children who had high dietary diversity score tertiles were 3.5 times more likely to be obese/overweight when compared to low dietary diversity score tertiles (AOR=3.48 [95% CI: 1.50-8.10]) **(Table 6).**

The level of total physical activities were not significant associated with childhood overweight and obesity (p>0.05) **(Table 6).**

Table 6. Multivariable logistic regression analysis predicting the likelihood of a child in Hawassa City to be obese/overweight, 2012 (n=358)

Variables	Overweight and obese (n=38)	Non overweight and non obese (n=320)	Crude OR [95%CI]	Adjusted OR [95%CI]
	No.[%]	No.[%]		
Age (months)				
36-47	23 [16.4]	118 [83.7]	2.63 [1.32-5.23] **	4.59 [1.52-6.46] ***
48-60	15 [6.9]	202 [93.1]	1	1
SES tertiles				
Low	5 (5.9)	80(94.1)	1	1
Medium	6 (4.9)	117(95.1)	0.82 [0.24-2.78]	-----
High	27(18)	123(82)	3.20 [1.17-8.74] **	3.51 [1.30-9.50] ***
Age of started IF				
0-3 months	1 [12.5]	7 [87.5]	1.44 [0.16-12.63]	------
4-6 months	24 [11.7]	182 [88.3]	1.83 [1.65-2.71] *	5.06 [2.09-8.33] **
> 6 months	13 [9]	131 [91]	1	1
Ice cream				
Yes	22 [15.3]	122 [84.7]	1.36 [1.23-5.89] *	3.84 [1.62-7.09] **
No	16 [7.5]	198 [92.5]	1	1
Sweet foods				
Yes	20 [16.3]	103 [83.7]	2.47 [1.22-6.84] **	6.36 [1.88-12.33] *
No	18 [7.7]	217 [92.3]	1	1
DDS tertiles				
Low	9 [6.1]	138 [93.9]	1	1
Medium	5 [8.3]	55 [91.7]	1.40 [0.45-4.35]	------
High	24 [15.9]	127 [84.1]	2.90 [1.30-6.45] **	3.48 [1.50-8.10] ***
Fast foods				
Yes	32 [13.4]	206 [86.6]	1.34 [1.14-4.84] *	8.69 [1.11-13.50] *
No	6 [5]	114 [95]	1	1
[#]TPAL				
Low	9[9.2]	89[90.8]	1.08[0.28-4.24]	----------
Moderate	23[10.8]	189[89.2]	1.29[0.37-4.58]	
High	3[8.6]	32[91.4]	1	

P < 0.05* P < 0.01** P < 0.001*** **[#]TPAL= Total physical activity level (P>0.05)**

DISCUSSIONS

The present study showed that the combined prevalence of overweight and obesity among children 3-5 years old in Hawassa City, South Ethiopia was 10.7%, of which 7.3% was overweight and 3.4% was obese.

This prevalence was comparable to reports of studies in some developed and developing countries. In developing countries obesity may co-exist with under-nutrition, with children in the relatively affluent urban areas more likely to be obese than their rural counterparts. Many studies of individual countries have noted increases in childhood obesity in recent years. Kalies *et al*. (2002) showed that obesity rates have increased from 1.8% to 2.8% among pre-school children in Germany, which is in the range lower than our finding; this might be due to the time gap between the previous studies and this study or it might be in developed countries have better prevention and control interventions towards childhood obesity than developing countries like Ethiopia. In China, prevalence of obesity in urban area was 12.6% (Lou & Frank, 2002), which is four times higher than the finding of the present study. It might be the socio-economic status variation even if the study was conducted few years back. As one study indicated that prevalence of overweight in Eastern Mediterranean region was 3%-9% (Musaiger, 2004), which is in the range closer to our finding. In Kenya, prevalence of obesity among children 3 to 5 years old was 4% (Gewa, 2010), which is almost a similar figure to the present finding. In Pakistan, prevalence of obesity among children was 7.5% (Muhammad *et al*., 2011), which is more than two times higher than the finding of present study; the possible reason, it could be in the study area of the children are less adopted to nutrition transition than in Pakistan children.

According to Wang & Lobstein (2006) reported that the prevalence of childhood obesity from different African countries as follows: Mauritius 4.0% (age 0 – 5 years), Nigeria 3.3% (0 – 6 years), Rwanda 2.1% (0 -5 years), Senegal 2.6% (0 – 5 years), Tanzania 1.5% (2 – 5 years), Uganda 1.6% (2 – 5 years), Zambia 2.2% (2 – 5

years) and Zimbabwe 4.2% (0 – 3 years). The obesity prevalence ranges from in this countries were lower than the finding except in Zimbabwe and Mauritius; the possible explanation, it might be due to the fact that, these studies were conducted more than a years ago and it has been a fast socioeconomic transition in Africa during the same period.

Prevalence of childhood overweight and obesity was not different in both sexes. The prevalence of overweight and obesity among boys was 9% and 3.4%, respectively while the prevalence among girls was 5.5% and 3.3%, respectively. Although it was not statistically significant, boys were higher in overweight than girls; however, almost there was no gender disparity in prevalence of obesity in present study. Similar finding was reported from Pakistan, more boys were overweight than girls and the association was not statistically in significant differences (Muhammad *et al*., 2011). According to WHO European Region from a total of 36 countries reported that boys have a higher prevalence of overweight and obesity than girls in almost all countries at all ages (Branca *et al*., 2007). In contrast the finding, children from South African and Kuwait region, the prevalence of obesity was 3.2% for boys and 4.9% for girls and overweight 14% for boys and 17.9% for girls (Armstrong *et al*., 2006) while in Kuwait, found that 4.7% of boys and 6.7% of girls were obese (Al-Mousa Z. & Parkash P. 2000). The present result showed that obesity among boys was slightly higher when compared to South African boys. But prevalence of overweight in both sexes was higher in South Africa than the present finding. In Kuwait the prevalence of obesity was higher in both sexes when compared to our girls and boys. Female gender was associated with childhood overweight or obesity (Kimani-Murage *et al*., 2011). The lower prevalence among girls in present finding, it might be due to the fact that majority of the girls joined school in early age than boys (mean age of school entry for boys (49.3) months and girls (36.2) months. This gave them the opportunity of playing in the school than home which is resulting in high physical activity. Also the total physical activity showed that majority of the girls were engaged in both moderate (64.4) and high (10.7) intensity physical activities than boys were engaged in both moderate (58.3) and high (9.5) intensity physical activities.

In present study, age was associated with childhood overweight and obesity. In both age groups, it decreased with increasing age. The highest prevalence of childhood overweight and obesity was observed in the age group of 36-47 months (16.4%), the values being 12% for overweight and 4.3% for obese, while the lowest prevelences were observed in the age groups 48-60 months (6.9%), the values being 4.1% for overweight and 2.8% for obese. A similar pattern of decreasing prevalence of obesity and overweight with age was reported from Kenyan urban settings (Gewa, 2010). The decreasing prevalence of overweight and obesity as age increases, it might be attributed to increase in moderate physical activity level (67.3) in age groups from 48-60 months than in moderate physical activity level (52.6) in age groups from 36-47 months. As WHO (2000) indicated that body weight increases are especially prevalent after three years of age (leading to an early adiposity rebound a physiological increase in the percentage of body fat at 5 or 6 years of age). Therefore, the first under five years of life may well be the best period for intervention regarding primary or targeted obesity prevention.

The prevalence of childhood overweight and obesity was statistically significant association with among high socioeconomic status (SES) ($P < 0.001$). Highest prevalence was seen among rich families (18%) than poor families (5.9%). One of the reason could be that those who are from high socio economic status will tend more to adopt industrialized or developed countries, that leads to an availability and high consumption of empty calorie junk foods, processed foods, sweet foods or high energy dense and low in fiber instead of the healthy traditional diet such as plant based food sources, low in fat, high fiber, fruits and vegetables. Another explanation might be, in present study Ethiopian societies, a fat child is thought to be a healthy child with better chances to survive the periods of undernourishment and infections and also belongs to a high socio-economic status family. While support to the present finding in developing nations childhood overweight and obesity is most prevalent in wealthier sections of the population. However, child obesity is also rising among the urban poor in these countries, possibly due to their exposure to westernized diets coinciding with a history of undernutrition (Lobstein *et al*., 2004). Similarly also Lobstein *et al.* (2004) stated that "overweight prevalence is high among the poor in rich countries and high among the rich in poor countries". In contrast the present finding, in most industrialized countries the prevalence of overweight and obesity has increased in children specifically among minorities and low socioeconomic status (Lobstein *et al*., 2004). The reason might be for example, if low energy-dense food were relatively more expensive than less healthy energy dense food, it may be that low SES groups could not literally afford to be thin. Jobs in developed countries have become increasingly sedentary and as a result, more people now have to give up alternative pursuits to exercise. In another study showed that children from Germany in families with low SES are at risk of becoming overweight/obesity compared to children from medium & high SES families (Danielzik *et al*. 2004; Kleiser *et al*. 2009). This is contrast to the present finding, which showed that children from households categorized in the high socioeconomic status tertiles were 3.5 times more likely to be obese/overweight as compared to the low socioeconomic status tertiles (AOR = 3.51 [95% CI: 1.30-9.50]). Similar finding from Pakistan, a study showed that children living in the urban area with high socioeconomic status (SES) were significantly at risk for being overweight and obese as compared to children living in the urban area with lower SES (AOR = 18.10 [95% CI: 10.24-32.00) (Muhammad *et al*., 2011).

In present study, early time of infant formula introduction was significantly associated with childhood overweight/obesity in the study population ($P < 0.01$). Similar finding reported that an early age of infant formula introduction was significantly associated with childhood overweight/obesity ($P < 0.05$) (Bogen *et al*., 2004). There was higher prevalence of childhood overweight/obesity among those who started formula feeding at age of 4 to 6 months (11.7%) as compared to those who started infant formula at later than six months (9%) in the study participants. This is indicating that an early introduction of formula feeding exposes children to overweight/obesity. The possible explanation might be infant formula feeding at an early age, the parents were believe that giving only breast feeding until six months not sufficient to promote growth of their child. Other possible reason for an early introduction of formula feeding could be that the majority of the study subjects are employed workers.

Regarding dietary habits in present study those who ate ice cream and sweet foods showed significant association with childhood overweight/obesity ($P < 0.01$) & ($P < 0.05$), respectively. Eating fast foods was significant association with childhood overweight/obesity in the study subjects ($P < 0.05$). Eating fast food has been identified as risk factors for childhood obesity (St-Onge *et al*., 2003). Similar findings showed that eating fast food has been identified as risk factors for childhood obesity (St-Onge *et al*., 2003). Frequency of sweets intake are associated with childhood overweight /obesity (Janssen *et al*., 2005). Other studies showed that dietary behavior such as frequency of sweets intake are associated with childhood overweight/obesity (Janssen *et al*., 2005). Consumption of fruits and vegetable was not associated with childhood overweight/obesity ($P > 0.05$). Similar finding showed that childhood overweight/obesity status was not associated with the intake of fruits and vegetables (Janssen *et al*., 2005; Pawloski *et al*., 2010).

In present study showed that a high dietary diversity score was statistically significant association with childhood overweight/obesity ($P<0.001$). A higher prevalence of overweight/obesity was observed in higher dietary diversity score (15.9%) than in both medium (8.3%) and low (6.1%) dietary diversity score. Dietary diversity could be a common determinant for the coexistence of under- and over-nutrition (Styen *et al.,* 2006). Similar finding, a study showed in Mexico a higher prevalence of obesity in the study participants with higher dietary diversity score (Ponce *et al.*, 2006). A study also showed in Tehran an increased prevalence and risk of obesity in the individuals with high dietary diversity due to the consumption of fruits and vegetables with oils and inclusion of the high sugar and fat as part of their diet in diversifying their diet (Azadbakht *et al*., 2005).

A limitation of the present study is used cross-sectional survey to assess the prevalence of childhood obesity/overweight and its associated factors which did not allow us to determine cause and effect relationship. In this study other factors which may affect excess body weight gain such as birth weight, health status of child, genetic factor and parent weight status and nutritional knowledge were not included. The food frequency questionnaire relies on memory of the respondents and was not validated. Global physical activity questionnaire used in the study was also not validated to be used for preschool children. There is limited information on childhood overweight and obesity in the study area.

CONCLUSIONS

In summary, this study shows that data on the prevalence and determinants of overweight and obesity among preschool children in Hawassa City, Ethiopia. With the world-wide increases in overweight and obesity being observed and this region being understudied. Ethiopia has long been considered one of the countries in Africa with very low rates of overweight, yet the present study suggests in this one capital city, at least, urban children are at risk of excessive weight gain. The study showed although the prevalence of overweight and obesity among preschool children in the study area were lower than some reported elsewhere, there is an emerging problem since the trend of the situations is rising rapidly given the trended rapid urbanization and changes in lifestyles and socioeconomic status transition. The present study showed that the association between socio-economic status and childhood overweight/obesity was observed in the study participants. Unlike in developed countries, childhood obesity/overweight in the study area is more prevalent in those of higher socio-economic status. Similar to other developing countries, overweight/obesity was more common among children with wealthier parents, early introduction of infant formula feeding, who ate a wide diversity of foods, consumed sweets and fast foods. Even though, while measures of total physical activity level were not associated with overweight/obesity.

Therefore, nutrition education should promote avoidance of early introduction of infant formula into the diets of children and exclusive breastfeeding during the first six months. Parents and children should be educated on good food consumption practices and trained to develop healthy eating behaviors. Parents should be discouraging frequent consumption of sweet and fast foods in to children's diet. Further research should be done on addressing all factors contributing to the occurrence of overweight and obesity among preschool children.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

TW designed the study and created the survey instrument. TB and DM participated in the design of the study and helped to write the manuscript. TB also contributed to statistical analysis and data interpretation and helped to write the manuscript. All authors read and approved the final manuscript.

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ABBREVIATIONS

WHO: World Health Organization; USAID: United States Agency for International Development; UNICEF: United Nations international Children's Fund; CSA: Central Statistical Agency; BMI: Body mass index; SPSS: Statistical Package for Social Science; PPS: Probability Proportional to Size; SD: Standard deviation; CI: Confidence Interval; AOR: Adjusted Odds Ratio; BAZ: Body Mass Index for Age z score; DDS: Dietary Diversity Score and SES: Socioeconomic status.

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ADDITIONAL TABLES, FIGURES AND INFORMATION

The sampling process by probability proportional to population size (PPS) selection

Selection of a sample of kebeles is performed by sampling with PPS. This is carried out by creating a cumulative size of preschool children (3-5 years) list of kebele population size and selecting a systematic sample from a random start. To take a sample of three kebeles from list of 20 kebeles, as shown in the Table below based on PPS sampling technique and then divide the total cumulative size of preschool children **(N=17,425)** by the number of kebeles to be selected (3) to obtain the sampling interval (17,425/3=5808). Choose random number between 1 and 5808, the selected random number is 3819. The kebele having an individual listed at 3819th will be the first kebele to be the sample. Now add the sampling interval to this random number to select the other two kebeles.

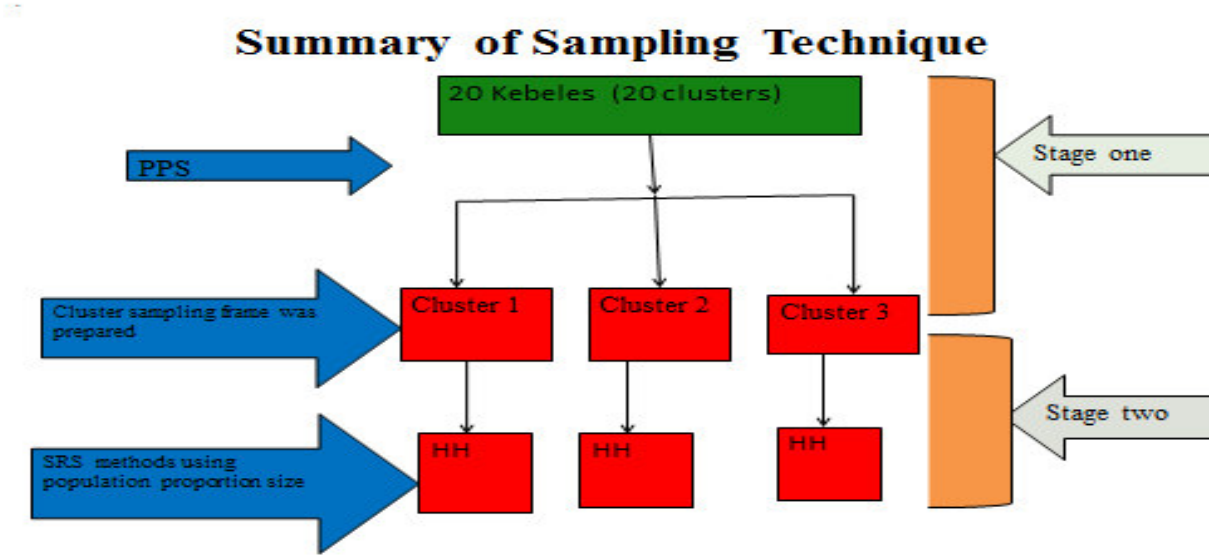
Table 1: A Cumulative size of children 3-5 years old with list of the kebele population sizes in Hawassa City, South Ethiopia, 2011/2012

S.No.	Name of kebeles	Registered total population size	Children (3-5yrs old)	Cumulative size of children (3-5yrs old)
1	Adare	4,333	433	433
2	Addis Ababa	8,413	841	1274
3	Andenet	2,208	221	1495
4	Daka	13,586	1,359	2854
5	Dume*	10,876	1,088	3942
6	Fara	7,350	735	4677
7	Filidelfia	7,265	727	5404
8	Gebeya dar	13,303	1,330	6734
9	Gudumale	4,054	405	7139
10	Guwi*	16,601	1,660	8799
11	Harer	3,434	343	9142
12	Hetata	12,593	1,259	10,401
13	Hoganne	11,575	1,158	11,559
14	Leku	6,472	647	12,206
15	Millennium*	8,104	810	13,016
16	Nigat Kokeb	4,130	413	13,429
17	Piassa	3,979	398	13,827
18	Teso	9,544	954	14,781
19	Tilte	15,092	1,509	16,290
20	Wukro	11,345	1,135	17,425

N.B. Star [*] ones are those selected kebeles by PPS.

Table 2: List of the three selected kebeles with the sample size drawn from each kebele (n=358)

S.No.	Name of the selected (3) clusters/kebeles	Estimated number of preschool aged children (3-5yrs)	Sample size drawn
1	Dume	1,088	109
2	Guwi	1,660	167
3	Millennium	810	82



Children's dietary diversity food groups

Dietary diversity is a qualitative measure of food consumption that reflects household access to a wide variety of foods, and is also a proxy of the nutrient adequacy of the diet for individuals. Individual Dietary Diversity Score (IDDS) is often used as a proxy measure of the nutritional quality of an individual's diet. For dietary diversity, a

simple count of the number of food groups is calculated. Specifically USAID guidelines suggest not including oils/fats, sugar/honey, and miscellaneous food groups because these food groups do not significantly contribute to a healthful diet. However, sugars, fats and oils do contribute to improved weight-for-age and weight-for height scores, if for nothing else other than the fact that these foods increase weight. The argument against their inclusion cites the potential to lead to negative health outcomes, namely childhood overweight and obesity. While recognizing this point, childhood overweight and obesity is not a widespread problem in Ethiopia. Therefore, when constructing the DDS, foods were classified in the following groups:

(1) Grains, roots or tubers
(2) Vitamin A-rich fruits and vegetables foods
(3) Other fruits or vegetables
(4) Meat, poultry, fish and seafood
(5) Eggs
(6) Pulses/legumes/nuts
(7) Milk and milk products
(8) Miscellaneous

The final group includes fats, oils, sugars, honey, tea, snack foods, soft drink beverages, soda and various commonly used spices (Swindale A. & Bilinsky P., 2006).

Total physical activity calculation guide

According to GPAQ comprise 16 questions grouped to capture physical activity undertaken in different behavioral domains, namely work, transport and discretionary activity (also known as leisure or recreation). In the transport, recreation and sport activities, the frequency and duration of all walking, cycling for transport, vigorous and moderate activities. One additional item is collected, i.e. time spent in sedentary activities. Metabolic Equivalents (MET) are commonly used to express the intensity of physical activities and are also used for the analysis of GPAQ data, existing guidelines have been adopted: it is estimated that, compared to sitting quietly, a person's caloric consumption is four times higher when being moderately active and eight times higher when being vigorously active. Therefore, when calculating a person's overall energy expenditure using GPAQ data, 4 METs get assigned to the time spent in moderate activities and 8 METs to the time spent in vigorous activities. For the calculation of a categorical indicator, the total time spent on physical activity during a typical week, the numbers of days as well as the intensity of physical activity are taken into account. The three levels of physical activity suggested for classifying children are low, moderate and high based on total physical activity calculation guide criteria (WHO, 2007).

Questions Used	P1-P15	
Program	Ptotallevels (unweighted), PtotallevelsWT (weighted)	
Equations	Total physical activity MET-minutes/week (= the sum of the total MET minutes of activity computed for each setting) Equation: Total Physical Activity = [(P2 * P3 * 8) + (P5 * P6 * 4) + (P8 * P9 *4) + (P11 * P12 * 8) + (P14 * P15* 4)]	
	Level of total Physical activity	Physical activity cutoff value
	High	• IF:(P2 + P11) ≥3 days AND Total physical activity MET minutes per week is ≥1500 OR • IF: (P2 + P5 + P8 + P11 + P14) ≥7 days AND total physical activity MET minutes per week is ≥3000
	Moderate	• IF: level of physical activity does not reach criteria for high levels of physical activity AND at least one of the following: • IF: (P2 + P11) ≥3 days AND ((P2 * P3) + (P11 * P12)) ≥ 3*20 minutes OR • IF: (P5 + P8 + P14) ≥ 5 days AND ((P5 * P6) + (P8 * P9) + (P14 * P15) ≥150 minutes OR • IF: (P2 + P5 + P8 + P11 + P14) ≥5 days AND Total physical activity MET minutes per week ≥600
	Low	IF level of physical activity does not reach the criteria for either high or moderate levels of physical activity

Table 3: Reliability test for global physical activity questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of GPAQ items
.806	.795	10

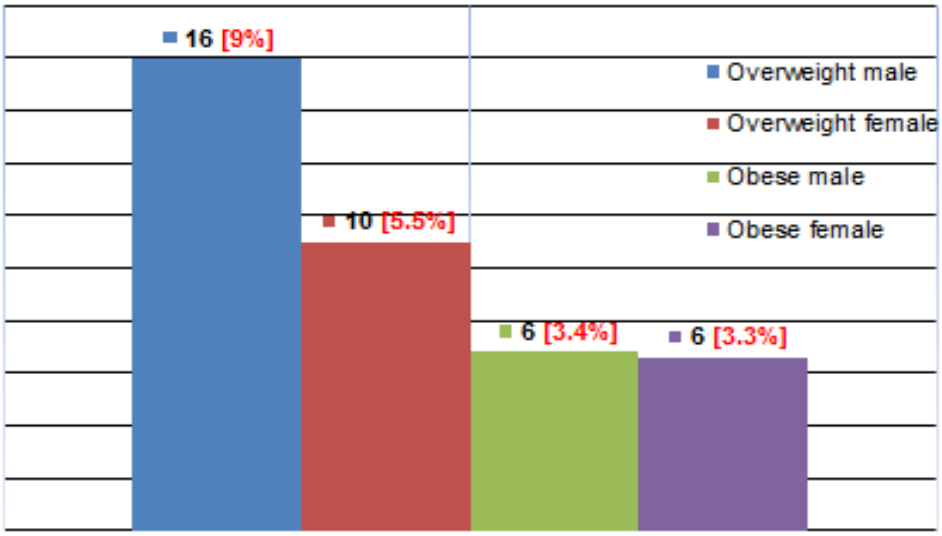


Fig.1. Prevalence of childhood obesity and overweight by gender in Hawassa City, 2012

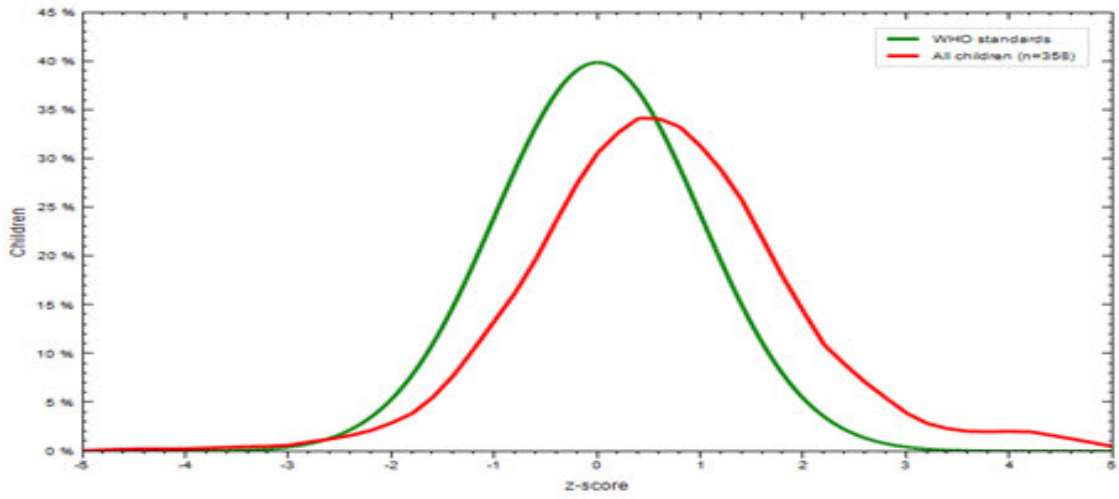


Fig.2. BMI-for-age z score of preschool children aged 36 to 60 months in Hawassa City population compared with WHO Standard, 2012

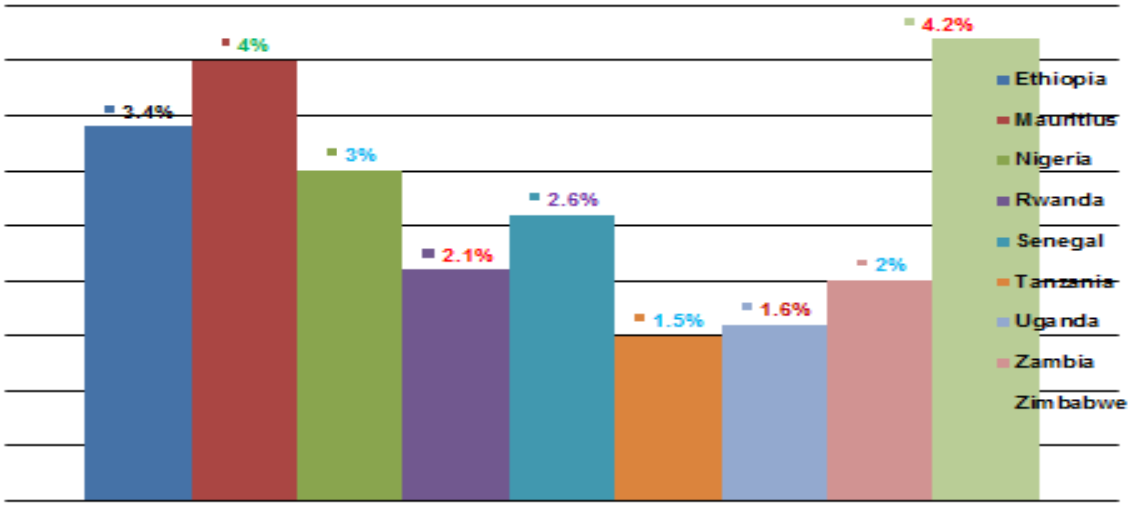


Fig.3. The prevalence of childhood obesity from various African countries when compared to study area

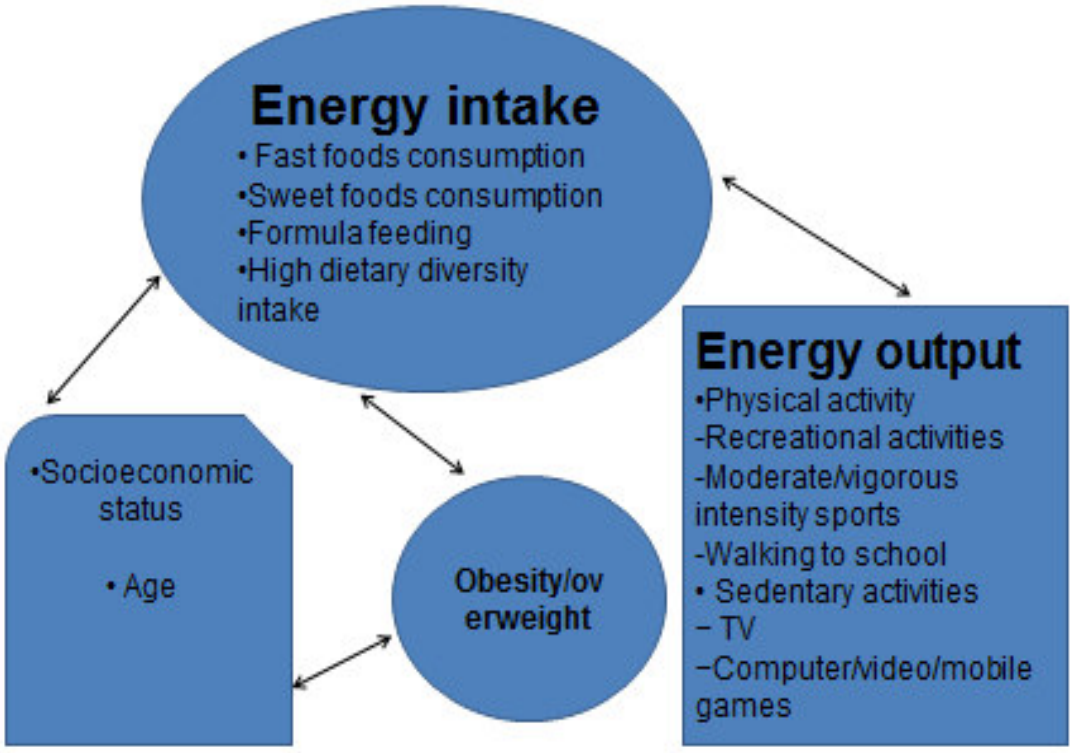


Fig.4. Risk factors of childhood overweight and obesity in Hawassa City, 2012

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