Journal of Public Health: From Theory to Practice (2019) 27:111–118
https://doi.org/10.1007/s10389-018-0919-3

ORIGINAL ARTICLE

Nutritional status of school children in eastern Hararghe administrative zone, eastern Ethiopia

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Received: 5 December 2017 / Accepted: 11 April 2018 / Published online: 3 May 2018

Abstract

Aim This study aimed to assess the nutritional status of school children in eight elementary schools in Eastern Ethiopia.

Subjects and methods A cross-sectional study was carried out among 1523 schoolchildren. The study subjects' height and weight were measured via anthropometric measurements, and their nutritional status was assessed using anthropometric indicators of the body mass index for age and height-for-age. The data were analyzed by AnthroPlus software and SPSS version 16.

Results One thousand five hundred twenty-three schoolchildren whose age ranged from 6 to 18 years participated in the study. The prevalence of stunting was 17.1%, thinness 17.9%, and over-nutrition 5.6% (overweight accounted for 4.4% and obesity 1.2%). Children aged 15–18 years were found to be more stunted than the children aged 6–9 years (AOR = 0.04, 95% CI = 0.02, 0.08) and 10–14 (AOR = 0.25, 95% CI = 0.14, 0.45). Children aged 15–18 years were also significantly thin for age compared with those aged 6–9 years (AOR = 0.31, 95% CI = 0.18, 0.56) and 10–14 (AOR = 0.34, 95% CI = 0.19, 0.59). Children from rural residences were significantly stunted (AOR = 0.37, 95% CI = 0.26, 0.51) and overnurished (AOR = 0.42, 95% CI = 0.25, 0.71) compared with the children from urban areas. Children who lived in urban areas were also significantly thin for age compared with those who lived in rural areas (AOR = 1.42, 95% CI = 1.08, 1.87).

Conclusion Undernutrition was an important problem among the school children in the study area. Stunting and thinness were significantly increased in the higher age group. Therefore, more effort should be made to improve the nutritional status of children aged 15–18 years in both the rural and urban study areas.

Keywords Malnutrition · Nutritional status · Stunting · Thinness · School children · Anthropometry · Eastern Hararghe · Ethiopia

Introduction

Malnutrition is a health problem that results from eating a diet that has either too few (undernutrition) or too many (overnutrition) nutrients. The term malnutrition is commonly used as an alternative to undernutrition (WHO 1995); however, in this study it refers to both under- and overnutrition.

Undernutrition has always been a major public health problem in developing countries, particularly in sub-Saharan Africa (Akombi et al. 2017). Some studies conducted in Ethiopia have reported 26.5% to 42.7% stunting (low height for age) and 21.6% to 58.3% thinness (low BMI for age) among school-age children in rural areas (Mulugeta et al. 2009; Mekonnen et al. 2013). Among the urban dwellers in this group, the range was 5.4% to 29.2 for stunting and 1.4% to 20.8% for thinness (Tadesse 2005; Reji et al. 2011; Amare et al. 2012; Nguyen et al. 2012; Amare et al. 2013; Herrador et al. 2014).

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Poverty is the main cause of undernutrition in the developing countries (Sachs and McArthur 2005). Moreover, the degree and distribution of undernutrition and micronutrient deficiency in a given population depend on many factors, including the politics and economy, education, sanitation, season and climate, food production, cultural and religious food customs, magnitude of infectious diseases, existence and effectiveness of nutritional programs, and the availability and quality of health services (De Waal and Whiteside 2003; Müller and Krawinkel 2005).

Today, the world is concerned with not only under- but also overnutrition. A recent study found that one-third of the world's population is overweight or obese, and 62% of them live in developing countries (Marie et al. 2014). The prevalence of overweight and obesity in children and adolescents in developing countries increased from 8.1% in 1980 to 12.9% in 2013. Such children tend to have high blood pressure, metabolic syndrome, non-insulin-dependent (type 2) diabetes, and psychological disorders (Marshall et al. 2004; Burke et al. 2008; Nguyen and El-Serag 2010).

In Sub-Saharan Africa, the sex and age of a child, the household's income, assets, wealth, and size; the household head's sex and occupation; and the mother's education are some of the factors associated with children's nutritional status (Nabag 2011; Abuya et al. 2012; Francis et al. 2012; Mwaniki and Makokha 2013). In addition, children who reside in rural areas have higher rates of stunting than those in urban areas (Nabag 2011; Oninla et al. 2007; Daboné et al. 2011).

In Ethiopia, undernutrition was found to be associated with the child's age and sex, family income, family size, intestinal parasitic and other infections, latrine availability, educational status of the head of the household, and consumption of food from animal sources (Mulugeta et al. 2009; Mekonnen et al. 2013; Reji et al. 2011; Nguyen et al. 2012; Herrador et al. 2014; Hall et al. 2008), while having a small family size, being in a male-headed household, doing no or little physical activity, frequent consumption of meat and fast food, and spending a lot of time watching television and on the computer are some of the factors associated with overweight and/or obesity in school children in urban settings in the country (Teshome et al. 2013; Alemu et al. 2014).

Studies on the nutritional status of school children would aid in prioritizing and setting up evidence-based nutritional intervention programs (Best et al. 2010). Therefore, this study has tried to assess the nutritional status of the school children in eight public elementary schools in the Eastern Hararghe administrative zone, eastern Ethiopia.

Methods

Study design and setting

A cross-sectional study was conducted among 1523 school children in eight public elementary schools in Eastern Hararghe administrative zone, Oromiya Regional State, from 15 March to 8 May 2014. Eastern Hararghe administrative zone is one of the zones of the Oromiya Regional State. The zone head office is located in Harar town, 525 km from Addis Ababa, the capital city of Ethiopia. It consists of 22 districts and 2 town administrations (Haramaya and Aweday town administrations). For this study, two town administrations and two districts (Haramaya and Kombolcha) were selected. Haramaya town administration is located 14 km west of Harar. It has a population of 28,835 and 6 elementary schools. The district of Haramaya encompasses the areas surrounding the Haramaya town administration. It has a population of 265,815 and 62 elementary schools. The Awadya town administration is located 10 km west of Harar. It has a population of 9057 and 6 elementary schools. The district of Kombolcha is located 15 km north of Harar. It has a total population of 156,421 and 35 elementary schools.

Sample size and sampling procedure

A single population proportion formula was used to estimate the sample size (Daniel 1995). The following assumptions were made: the proportion of undernutrition (stunting) among school children in the area was 22.3% ($p = 0.223$) (Hall et al. 2008) with a 95% confidence interval, 3% margin of error ($d = 0.03$), and design effect of 2. Ten percent of the sample size was added to minimize errors arising from the likelihood of non-compliance, which gave a final sample size of 1628. The final sample size was allocated proportionally to the total number of students in the eight selected elementary schools. Finally, using class rosters as a sample frame, the sampled children were selected by a random sampling technique. Children who had taken treatment for intestinal helminths during the month prior to the survey were excluded.

Data collection

Socio-demographic survey

A structured questionnaire, translated from English into two local languages (Amharic and Oromifa), was used to collect data on the age, sex, residence, religion, ethnicity, family size, and maternal educational status. The questionnaire was pretested in Babile Elementary School in Babile town, Ethiopia, to assess the suitability of the questionnaire regarding the duration, language appropriateness, and question comprehensibility. It was administered by trained interviewers.

Anthropometric measurement

Relevant and carefully designed training was given to the data collectors to avoid measurement errors. The weight and height of the study subjects were measured twice, and even a third time when inconsistencies or implausible values were obtained. In addition, the weighing scale was well calibrated every morning using a known weight. Body weight was determined to the nearest 0.1 kg on an electronic digital scale (Seca, Germany, quality control no. 5106, maximum: 150 kg, mcd 3,811,021,659), and the children were measured wearing light clothes and barefoot.

The height of study participants was obtained by measuring the barefoot children using a centimeter tape fixed on a wooden board and posted vertically on the wall. The participants stood on a flat surface with their heels, buttocks, scapulae, and head against the wall and their arms hanging freely. Their head was positioned in a Frankfort horizontal plane. A wooden headpiece was lowered until it touched the head of the child, and the height was recorded to the nearest 0.1 cm (WHO 1995).

Parasitological examination

The selected children were supplied with labeled plastic containers, waterproof papers, and applicator sticks. They were instructed to bring stool samples of about 2 g. Then, the samples were emulsified in a 10% formalin solution and transported to Haramaya University Collage of Health and Medical Sciences Parasitology Laboratory. The McMaster method was used for estimating the number of eggs per gram of stool to determine the intensity of infection at an individual level (Levecke et al. 2009). The children who were found positive for intestinal parasites were given the appropriate anti-parasite chemotherapy by a medical doctor.

Assessment of malnutrition

The Z score values for height for age and BMI for age were calculated by WHO AnthroPlus softwares (WHO AnthroPlus for personal computers Manual 2009). Overweight (> + 1 SD BMI-for-age Z score), obesity (> + 2 SD BMI-for-age Z score), thinness (acute undernutrition) (< −2 SD of BMI-for-age Z score), and stunting (chronic undernutrition) [< −2 SD of height-for-age (HAZ) Z score] were defined according to the WHO reference (de Onis et al. 2007).

Statistical analysis

Data were analyzed using SPSS version 16.0. Bivariate analysis and multivariate logistic regression models were used to describe the significance of the association between the nutritional status outcome variables (stunting, thinness, and overnutrition; overweight and obesity) and predictor variables (age, sex, residence, religion, maternal educational status, family size, and intestinal helminth infections). The crude odds ratio (COR) and adjusted odds ratio (AOR) with 95% confidence intervals (CI) were reported. Statistical significance was set at $p < 0.05$.

Ethical consideration

Ethical clearance was obtained from the Institutional Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University. The objective and benefit of the study were thoroughly explained. Informed and written consent was obtained from the parents or guardians of the study participants.

Results

Socio-demographic characteristics of children

A total of 1523 school children from 8 primary schools participated in this study, which had an overall response rate of 93.6%; 840 (55.2%) were male, and their ages ranged from 6 to 18 years, with a mean of 9.81 years (SD ± 2.35). The majority (57.4) live in rural areas. Most were Muslim (91.3%), and 93.2% were from the Oromo ethnic group. The average family size was 6.53 (SD ± 2.11), and 68.9% live in households with 6 or more family members. The majority (75.5%) of the respondents' mothers were illiterate. Two hundred eighty of them (18.4%) had intestinal helminths infections, 8.9% of which was *Hymenolepis nana* followed by hookworm, *Enterobius vermicularis, Ascaris lumbericoides, and Trichuris trichiura* with prevalence rates of 4.6%, 3.3%, 1%, and 0.6%, respectively (Table 1).

The mean height, weight, and BMI of the school children aged 5–9 years were 128.1 cm (SD ± 8.99), 24.2 kg (SD ± 4.79), and 14.68 (SD ± 1.87), respectively; the mean height, weight, and BMI for those 10–14 years of age were 138.7 cm (SD ± 10.67), 30.8 kg (SD ± 6.91), and 15.91 (SD ± 2.25), respectively, and 151.4 cm (SD ± 13.85), 39.8 kg (SD ± 9.35), and 17.10 (SD ± 2.80) respectively, for those 15–18 years of age. The mean height, weight, and BMI of the male school children were 134.3 cm (SD ± 11.78), 28.16 kg (SD ± 7.04), and 15.43 (SD ± 2.20), respectively, and of females 133.5 cm (SD ± 11.85), 27.64 kg (SD ± 7.58), and 15.25 (SD ± 2.24), respectively.

Nutritional status of children

The prevalence of stunting was 17.1%, of thinness 17.9%, and of overnutrition 5.6%, of which overweight and obesity accounted for 4.4% and 1.2%, respectively.

Table 1 Socio-demographic characteristics and intestinal parasite infection of school children in the eastern Harerge zone, eastern Ethiopia, 2014

Variable	Number	Percent
Sex		
Male	840	55.2
Female	683	44.8
Age in years		
6–9	756	49.6
10–14	709	46.6
15–18	58	3.8
Residence		
Urban	649	42.6
Rural	874	57.4
Religion		
Christian	133	8.7
Muslim	1390	91.3
Ethnicity		
Oromo	1419	93.2
Amhara	100	6.6
Others (Gurage, Harari)	4	0.2
Maternal education		
Illiterate	1150	75.5
Literate	373	24.5
Family size		
2–5	473	31.1
> 5	1050	68.9
Intestinal helminth infection		
Infected	280	18.4
Not infected	1243	81.6

In the bivariate logistic regression model, stunting was significantly associated with age (COR = 0.06, 95% CI = 0.03, 0 .10; 0.31, 95% CI = 0.17, 0.52), residence (COR = 0.42, 95% CI = 0.31, 0 .56), and religion (COR = 1.68, 95% CI = 1.10, 2.55). After adjustment of the multivariate logistic regression model, age and residence were independent predictors of stunting. Children 15–18 years of age were 96% (AOR = 0.04, 95% CI = 0.02, 0.08) and 75% (AOR = 0.25, 95% CI = 0.14, 0.45) times more likely to be stunted compared with children who were 6–9 and 10–14 years of age, respectively. Moreover, children who lived in rural areas were 63% (AOR = 0.37, 95% CI = 0.26, 0.51) times more likely to be stunted compared with children who lived in urban areas (Table 2).

In the bivariate logistic regression model, thinness was significantly associated with age (COR = 0.29, 95% CI = 0.17, 0.52; 0.32, 95% CI = 0.18, 0.57) and residence (COR = 1.41, 95% CI = 1.08, 1.83). After adjustment, in the multivariate logistic regression model both age and residence remained independent predictors of thinness. Children 15–18 years of age were 69% and 66% more likely to be thin for age compared with children in the 5–9-year group (AOR = 0.31, 95% CI = 0.18, 0.56, $P = 0.000$) and 10–14-year group (AOR = 0.34, 95% CI = 0.19, 0.59, $P = 0.000$) years of age, respectively. The children who lived in urban areas were 1.4 (AOR = 1.42, 95% CI = 1.08, 1.87, $P = 0.010$) more likely to be thin for age compared with children in rural areas (Table 3).

Using the bivariate logistic regression model, we found that overnutrition (overweight and obesity) was significantly associated with residence (COR = 0.38, 95% CI = 0.23, 0.64) and intestinal helminth infection (COR = 0.59, 95% CI = 0.36, 0.98). After adjustment using the multivariate logistic regression model, residence remained an independent predictor of overnutrition. Children who lived in rural areas were 58% more likely to have overnutrition than children in urban areas (AOR = 0.42, 95% CI = 0.25, 0.71, $P = 0.001$) (Table 4).

Discussion

There were more female study participants (44.8%) than in the study conducted in 2001 in the nearby region, Babile town (34.7%) (Tadesse 2005). This might indicate increased school enrollment of female children. The mean age was 9.8 years ranging from 6 to 18 years, while mean age was 11.2 years ranging from 5 to 24 years. The prevalence of intestinal parasites was lower (18.4%) than in the study in Babile town (27.2%), but the predominant parasite involved was *H. nana* followed by hookworm in both study areas (Tadesse 2005). Higher prevalence of intestinal parasites was also reported in studies conducted in the northern part of Ethiopia, and the predominant parasite involved was *Ascaris lumbricoides* and *Schistosomia mansoni* (Mekonnen et al. 2013; Amare et al. 2012, 2013).

The levels of stunting (17.1%) and thinness (17.9%) in this study were higher than the ones found by a similar study done in 2001 in Babile, where 5.2% of the school children were stunted and 11.6% were thin for age (Tadesse 2005). The difference might be due to differences in socioeconomics, environmental conditions, inadequate dietary intake, and illness. However, the levels are lower than those reported by Tigray (26.5% and 58.3%) (Mulugeta et al. 2009), Fogera district (30.7% and 37.2%) (Mekonnen et al. 2013), Fogera and Libo Kemkem districts (42.7% and 21.6%) (Herrador et al. 2014), and a national survey conducted by Hall et al. (22.3% and 23.1%) (Hall et al. 2008).

The prevalence of stunting and thinness showed a definite trend across age groups (Tables 2 and 3). Older school children (15–18 years of age) who lived in both rural and urban areas were significantly stunted and thin for age compared with younger school children (6–9 and 10–14 years of age). The higher rate of stunting among older school children showed an increasing vulnerability with age since stunting is

Table 2 Prevalence of stunting in school children in eastern Harerge zone, eastern Ethiopia, 2014

Variable	Stunting		COR(95% CI)	AOR(95% CI)	P value
	Stunted	Not stunted			
Sex					
Male	148 (17.6)	692 (82.4)	1.08(0.83, 1.41)	0.84(0.62, 1.13)	0.252
Female	113 (16.5)	(83.5)570	**1**		
Age in years					
6–9	46(6.1)	710(93.9)	0.06(0.03, 0.10)	0.04(0.02, 0.08)	0.000
10–14	184(26)	525(74)	0.31(0.17, 0.52)	0.25(0.14, 0.45)	0.000
15–18	31(53.5)	27(46.5)	**1**		
Residence					
Urban	69(10.6)	580(89.4)	0.42(0.31,0 .56)	0.37(0.26, 0.51)	0.000
Rural	192(22)	682(78)	**1**		
Religion					
Christian	33(24.8)	100(75.2)	1.68(1.10, 2.55)	1.44(0.83, 2.49)	0.186
Muslim	228(16.4)	1162(83.6)	**1**		
Maternal education					
Illiterate	199(17.3)	951(82.7)	0.95(0.69, 1.30)	1.01(0.67, 1.52)	0.947
Literate	62(16.6)	311(83.4)	**1**		
Family size					
2–5	71(15)	402(85)	1.05(0.76, 1.43)	0.90(0.64, 1.26)	0.542
> 5	190(18.1)	860(81.9)	**1**		
Intestinal helminths					
Not infected	212(17.1)	1031(82.9)	0.96(0.68,1.36)	0.92(0.63, 1.33)	0.661
Infected	49(17.5)	231(82.5)	**1**		

COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval

a long-term (cumulative) indicator of slow growth that begins in early childhood and persists throughout the school-age years (Amare et al. 2012; Daboné et al. 2011; Partnership for Child Development 1998; Prista et al. 2003). A similar observation has been reported by other studies in Ethiopia (Hall et al. 2008; Mulugeta et al. 2009) and Tanzania (Lwambo et al. 2000), Kenya (Mwaniki and Makokha 2013), Burkina Faso (Daboné et al. 2011), Mozambique

Table 3 Prevalence of thinness in school children in eastern Harerge zone, eastern Ethiopia, 2014

Variable	Thinness		COR(95% CI)	AOR(95% CI)	P value
	Thin for age	Not thin forage			
Sex					
Male	160(19)	680(81)	1.20(0.92, 1.56)	1.19(0.91, 1.56)	0.195
Female	112(16.4)	571(83.6)	**1**		
Age in years					
6–9	124(16.4)	632(83.6)	0.29(0.17, 0.52)	0.31(0.18, 0.56)	0.000
10–14	125(17.6)	584(82.4)	0.32(0.18, 0.57)	0.34(0.19, .59)	0.000
15–18	23(39.7)	35(60.3)	**1**		
Residence					
Urban	135(20.8)	514(79.2)	1.41(1.08, 1.83)	1.42(1.08, 1.87)	0.010
Rural	137(15.7)	737(84.3)	**1**		
Religion					
Christian	27(20.3)	106(79.7)	1.19(0.76, 1.85)	1.26(0.75, 2.14)	0.375
Muslim	245(17.6)	1145(82.4)	**1**		
Maternal education					
Illiterate	206(17.9)	944(82.1)	1.02(0.74, 1.37)	1.09(0.76, 1.56)	0.623
Literate	66(17.7)	307(82.3)	**1**		
Family size					
2–5	85 (18)	388 (82)	1.01(0.76, 1.34)	0.97(0.72, 1.31)	0.848
> 5	187(17.8)	863 (82.2)	**1**		
Intestinal helminths					
Not infected	227(18.3)	1016(81.7)	1.16(0.82, 1.65)	1.08(0.76, 1.55)	0.644
Infected	45(16.1)	235(83.9)	**1**		

COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval

Table 4 Prevalence of overnutrition (overweight and obesity) in school children in eastern Harerge zone, eastern Ethiopia, 2014

Variable	Overnutrition (overweight + obesity)		COR(95% CI)	AOR(95% CI)	P value
	Overnourished	Not overnourished			
Sex					
Male	52 (6.2)	788(93.8)	1.26(0.80,1.96)	1.19 (0.76, 1.88)	0.431
Female	34 (5)	649(95)	**1**		
Age in years					
6–9	49 (6.5)	707 (93.5)	1.94 (0.46, 8.18)	1.94 (0.45, 8.33)	0.370
10–14	35 (4.9)	674 (95.1)	1.45 (0.34, 6.20)	1.49 (0.34, 6.46)	0.588
15–18	2 (3.4)	56 (96.6)	**1**		
Residence					
Urban	20 (3.1)	629 (96.9)	0.38 (0.23, 0.64)	0.42 (0.25, 0.71)	0.001
Rural	66 (7.6)	808 (92.4)	**1**		
Religion					
Christian	4 (3)	129 (97)	0.49 (0.17, 1.37)	0.63 (0.20, 1.97)	0.430
Muslim	82 (5.9)	1308 (94.1)	**1**		
Maternal education					
Illiterate	69 (6)	1081 (94)	1.33 (0.77, 2.30)	1.01 (0.55,1.85)	0.965
Literate	17 (4.6)	356 (95.4)	**1**		
Family size					
2–5	20 (4.2)	453 (95.8)	0.65 (0.39, 1.09)	0.78 (0.45, 1.32)	0.361
> 5	66 (6.3)	984 (93.7)	**1**		
Intestinal helminths					
Not infected	63 (5.1)	1180 (94.9)	0.59 (0.36, 0.98)	0.69 (0.42, 1.15)	0.160
Infected	23 (8.2)	257 (91.8)	**1**		

COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval

(Prista et al. 2003), and Brazil (Parraga 2006). The higher rate of thinness for age among older school children might be due to extra demands that come as children grow, creating a need for energy that is much greater than that of early school children (Francis et al. 2012). A similar observation had been reported by studies in Ethiopia (Mulugeta et al. 2009; Herrador et al. 2014; Amare et al. 2012), Uganda (Francis et al. 2012), and India (Fazili et al. 2012).

The prevalence of thinness indicators of current (short-term) malnutrition was found to be significantly higher among children 6–14 years of age attending rural schools than among those in urban schools in a similar age group. It was in agreement with studies conducted in Sudan (Nabag 2011), Nigeria (Oninla et al. 2007), and Burkina Faso (Daboné et al. 2011). This might reflect increasing food prices and inadequate incomes of urban families to purchase food. For example, in the Makuru slums in Nairobi, poor households spend up to 70% of their income on basic foods, buying 90–100% of their household food. As a result, poor urban households are more vulnerable to increased food prices (Cohen and Garrett 2010), because the population in rural areas may have agricultural fields and therefore might have better access to and food security. In addition, the rural community in this area produces "chat," the main cash crop (an agricultural crop grown for sale to return a profit) in this area that might increase their income. A study conducted in northern Ethiopia also found that families that cultivated rice (the main cash crop in the area) had a better socioeconomic status compared with non-rice cultivating families (Herrador et al. 2014).

The prevalence of stunting was found to be significantly higher among children 6–14 years of age attending rural schools than among those in urban schools in a similar age group. This was in agreement with a study conducted in Fogera and Libo Kemkem districts, northwest Ethiopia (Herrador et al. 2014), Sudan (Nabag 2011), Nigeria (Oninla et al. 2007), Burkina Faso (Daboné et al. 2011), India (Mitra et al. 2007), Nepal (Stewart et al. 2009), and Laos (Miyoshi et al. 2005). This might be attributed to the higher prevalence of stunting, which is frequently the result of nutritional challenges taking place before 24 months of age and persisting throughout the school-age years (Amare et al. 2012; Daboné et al. 2011; Partnership for Child Development 1998; Prista et al. 2003) in rural compared with urban communities. Stunting was much greater among children under 5 years of age in rural areas (40%) than in urban areas (25%) (EDHS 2016).

The level of overnutrition in this study was 5.6%. This prevalence is similar to that reported from Mozambique (6.3%) (Prista et al. 2003) and greater than the prevalence reported from Burkina Faso (2.3%) (Daboné et al. 2011). However, it is less than what was found in the United Arab Emirates (33.6%) (Junaibi et al. 2013), Guatemala (32.1%) (Groeneveld et al. 2007), Egypt (20.5%) (FAO 2006), Hawassa, Ethiopia (15.6%) (Teshome et al. 2013), and

Addis Ababa, Ethiopia (9.4%) (Alemu et al. 2014). The low prevalence of overnutrition in this study might be due to the difference in major risk factors of overnutrition such as lack of physical activity, frequency of meat consumption, and time spent watching television or using the computer (Teshome et al. 2013; Alemu et al. 2014). Children who lived in rural areas were 58% more likely to have overnutrition compared with children who lived in urban areas. This might be due to the higher intake of animal-source food by rural than urban families (Herrador et al. 2014; Mekonnen et al. 2013).

Limitation

The present study was conducted only in a few districts of Ethiopia. Thus, the findings may not be generalizable to a larger population. In addition, we believe that our study should have included the family income, dietary knowledge of the mothers, infections other than parasitic infections, and the dietary intake of the children.

Conclusion

The study shows that undernutrition (stunting and thinness) constituted a major health problem among school children in the present study area. Both stunting and thinness significantly increase with increasing age. Significant urban-rural differences remained in the multivariable model, and area of residence is still a predictor of the children's nutritional status. Stunting (chronic undernutrition) was significantly higher among rural than urban children, while thinness (acute undernutrition) was significantly higher in urban than rural children. This calls for policies and programs geared toward improving children's welfare and paying particular attention to school-age children in the rural as well as urban areas.

Acknowledgements We acknowledge the Haramaya University research and publication office for budget allocation and all the participants for their willingness to participate in this study. We would also like to extend our thanks to each district and town administration health and educational bureau and director, the teachers in each studied school and Ms. Serawit Tamrat and Ms. Meskerem Yeshitla for their unreserved support during data collection and sample processing.

Authors' contributions All authors contributed equally to all aspects of this research work and have read and approved the final version of the manuscript.

Compliance with ethical standards

Conflict of interests All the authors declare that they have no conflict of interest associated with the publication of this manuscript.

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