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School-Aged Children Felling Hunger at School Were at a Higher Risk for Thinness in Kersa District, Eastern Ethiopia: A Cross-Sectional Study

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Abstract

Background: Thinness in school children is a serious health condition with serious consequences for their development, health, and well-being. The objective of this study was to assess the magnitude and associated factors of thinness among school age children in Eastern Ethiopia.

Methods: A cross sectional study was conducted among school age children in Eastern Ethiopia. A child was identified as thin if Body Mass Index for -age Z-score is below minus two standard deviations.

Result: Thinness was observed among 206 of 1768 school children [11.6%; 95% CI; CI 10.1- 13.1); about 2% had very low BMI for age. Children in the age group 13-14 years had 1.62 times the risk of thinness compared to children aged 5-9 years (AOR=1.62; 95% CI: 1.06, 2.39). The risk of thinness among children reported felling hunger at school was 1.55 times as high as the risk of thinness compared to children who did not report felling hunger at school (AOR=1.55; 95% CI: 1.07, 2.23). Children from families who did not have latrine had 1.53 times the risk of thinness compared to children from families who had latrine (AOR=1.53; 95% CI: 1.09, 2.13). On the other hand, children born to older mother (age ≥ 35 year) had 30% less risk of being thin compared to children born from younger mothers (AOR 0.70; (95% CI), 0.51-0.98).

Conclusion: This study provided evidence that over 10% of school children were under acute nutritional stress in the form of thinness. Thus, integration of nutrition interventions into a comprehensive school health program including free school meals can potentially benefit those children.

Keywords: Thinness; BMI; School children; Kersa; Ethiopia

Background

Nutritional deficiencies are a public health concern in school children especially in resource poor countries. Nutritional disorders beginning in the pre-school age may progress into school age if untreated and may have significant negative effects on the academic performance and general well-being of the child [1]. Thinness (low BMI-for-age) indicates acute under-nutrition, usually because of insufficient food intake or a high incidence of infectious diseases [2,3]. In school-aged children, it can impact their health, cognition, and subsequently their educational achievement [4].

To develop to their optimal potential, it is vital that children are provided with nutritionally sound diets. In many parts of the world, children come to school with empty stomachs. As a result, they come to school with little energy to concentrate or participate in classes [5,6].

A review of literature published from 2002 to 2009 on the nutritional status of school aged children from Latin America, Africa, Asia, and the Eastern Mediterranean region indicated that the average prevalence of thinness was around 35% in both Africa and South- East Asia and was less than 15% in all other regions [4].

In Ethiopia despite a lot of efforts over the past decades to address under nutrition, the levels of nutritional indices are high but showing decreased trends. Previous study findings of the nutritional status of school children from different regions of Ethiopia showed that the prevalence of thinness ranging 23.3- 50%, which indicated that under nutrition, is a public health problem [7-10].

The nutritional status assessment of school children, can serve to identify children who may need nutritional intervention and so prevent further deterioration in their nutritional status and reducing the risk of poor performance in school [11]. Anthropometric measurements have become an internationally recommended practical tool for evaluating the nutritional status of populations, particularly of children in developing countries [12].

Although the health, cognition and educational achievement of school-aged children are influenced by their nutritional status, school-aged children are not usually part of health and nutrition surveys. As a result, there is little documented information on the nutritional status of school children and adolescents from Eastern Ethiopia. Therefore, using anthropometric index, the objective of this study was to investigate the prevalence of thinness and associated factors among school children aged 5-14 years living in Kersa district. Findings obtained from this study may assist the National School Health and Nutrition Strategy of Ethiopia [13] in planning and undertaking nutrition intervention programs which can benefit school children and adolescents.

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Methods

This cross sectional study was conducted among school children aged 5-14 years in 12 public primary schools of Kersa district, East Hararge Zone, Oromia regional state, Eastern Ethiopia. The survey was conducted during January - February 2012.

The study population was student-parent pair, students were identified in schools and their parents contacted through the demographic surveillance system operating around the schools selected for the study. The calculated sample size for determining the magnitude of thinness was 1988, assuming prevalence of 27% at 95% confidence level and a margin of error of 2 [14]. Ten percent non-response rate was added to the sample size as a contingency. The adequacy of the sample size for addressing factors associated with thinness was checked.

In each school sampling frame was prepared from the student roster in each grade. The sample size was distributed among the schools proportionally based on the student size in each school. Students were selected randomly. All schools involved in this study were located within the geographic limit of the Demographic and Health surveillance (KDH-HRC) site which is managed by Haramaya University. Thus, parents were contacted through the surveillance field workers.

Data Collection

Data were collected using a pre-tested structured questionnaire translated into the local language (*Afan Oromo*) by trained and experienced data collectors who were fluent in the local language. The data collection tool was prepared based on the national survey questionnaire [7]. Respondents of the questionnaire were parents/caregivers of the children identified in the study schools. After students were selected randomly in the schools their household number was traced in the KDH-HRC database. Then, data collectors visited the children's house to administer the questionnaire to one of the parents/care takers. Unique identifier was given to link the children anthropometric measurement and household characteristics.

Anthropometric Measurements

Anthropometric measurements of weight and height of the selected children were measured according to WHO standard procedures [12,15]. All measurements were done at the school premises. Weight was measured to the nearest 0.1 kg with an electronic digital scale (Seca ©, Columbia, MD, USA) with children wearing only light clothing and without shoes. The scale was periodically calibrated to ensure accuracy using standard weights. Height was measured to the nearest 0.1 cm using a locally manufactured wooden stadiometres with a sliding headpiece. The BMI was computed as weight in kg divided by height in m^2.

To ensure data quality, training of data collection team, standardization of measurements, pre-testing of procedures and materials and field monitoring of data collection was done. Timely availability of the study instruments, meeting of data collection team at the end of everyday to share experiences and submit completed forms, and solving field problems was ensured.

Based on the adapted UNICEF's malnutrition conceptual framework and previous studies [4,6] the independent variables included in the study were the individual characteristics (child's age, sex, morbidity status, and felling hunger at school), house hold characteristics s(Number of children in the household, educational status and occupation of parents, wealth index, age of the mother, and environmental characteristics (water source, waste disposal system and availability of latrine at the household level).

Principal component analysis (PCA) was used to derive a wealth index from information on ownership of the household assets. Principal Components with eigenvalues greater than one were retained to construct wealth index values and then categorized into three relative measures of socio economic status of households as low, medium and high.

BMI was calculated as the ratio of weight in Kg to height in m squared (kg/m^2). Thinness was determined using the age and sex specific WHO cut-offs provided for -1, -2 and -3 standard deviations (SD) for BMI-for-age, of which <-2 SD defines "thinness" and <-3 SD "severe thinness" '[3].

Statistical Analysis

The data were double entered using EpiData 3.1 software by trained data clerks and analyzed using STATA version 11. Descriptive statistics, (frequency counts and percentages) were used to summarize categorical variables while mean and standard deviations were used to present continuous variables. Logistic regression model was employed to ascertain any significant association between independent variables and dependent variable. Based on the knowledge of UNICEF's malnutrition conceptual framework [16,17] and previous studies three independent logistic regression models were constructed to categorize the risk factors of malnutrition among school-age children. At the first level (basic) house hold factors, second level environmental (underlying) factors and at the third level (proximate) child characteristics were included in the model. Variables with P<0.2 in the bivariate analysis were considered in the multivariate analysis, along with variables that were well known predictors of thinness such as child sickness in the last 2 weeks. In the final multivariate logistic regression model, statistical significance was considered at $P < 0.05$ and adjusted odds ratios (AOR) with 95% CI.

The z-score values for BMI-for-age were calculated using the WHO Anthro Plus soft ware [(WHO 2009). Calculated Z-scores of Body Mass Index for age (BAZ) was then used to classify thinness, using the new WHO 2007 reference values for school boys and girls (WHO Multicentre Growth Reference Study Group 2006). Thinness was determined using the age and sex specific WHO cut-offs are provided for -1, -2 and -3 standard deviations (SD) for BMI-for-age, of which <-2 SD defines "thinness" and <-3 SD "severe thinness".

Ethical clearance was obtained from the College of Health Science of Haramaya University. An anthropometric measurement was performed after obtaining a signed written informed consent from parents and an oral assent from the children. Privacy and confidentiality were maintained at each step of the study process.

Result

Demographic characteristics of the students

A total of 1768 school children 5-14 years participated in the study. The male-female ratio was 1. 34 with 57.3% boys and 42.7% girls. The mean age of school children was 10.7 years (SD ± 2.1). Most of the children (45.4%) were early adolescent 10-12 years while 30.6% were preadolescents 5-9 years. Fifty-two percent of the children were from the mother with age group of 24-34 and the average age of mothers was 36.2 with standard deviations of ±7.6.

Eighty-four percent of the children were from rural and 16% were

from semi-urban. Sixty eight percent of the fathers and 78 % of the mothers were illiterate. Majority of the mothers 1487 (93.4%) were housewives. Most children (77.1%) came from families with more than four children, and 22.9% children were from family's less than 4 children (Table 1).

Nutritional status of school children

Mean (±SD) BMI-for-age z-score was -0.9 (±0.98). Thinness affected 11.6% (95% CI 10.1-13.1) of schoolchildren; of these 1.9% had severe low BMI for age (< -3 SD of BMI for age z-score). There was a difference observed in the prevalence of thinness between boys (12.9%) and girls (9.9%). The differences in the prevalence of thinness across age groups were statistically significant. The 13-14 years-old children were the most affected group by thinness (14.6%) as compared to children aged 5-9 years (9.8%) and 10-12 years (11.3%). This trend was statistically significant (P<0.05) (Table 2).

Multivariate analysis with logistic regression model was used to compute the adjusted OR and 95% confidence interval of each variable. In the first regression model, socio-demographic and economic variables (Residence, age of the mother, educational and occupational status and wealth status) were included. None of the variables showed significant associations with thinness (Table 2). In the second regression model, lack of improved facility of toilet at house hold [AOR (95% CI)=1.37 (1.01, 1.86)] was significantly associated with thinness among the environmental factors while in the third model, child age 13-14 [AOR (95% CI) =1.56 (1.05, 2.31)] and felling hunger at school [AOR(95% CI) =1.58 (1.23, 2.27)] were significantly associated with thinness among the individual level factors (Table 2).

In the final multivariable model, variables from the first, second and third model were put together. After controlling the effect of other factors, children at the age of 13-14 years are 1.62 times more likely to be thin as compared to children aged 5-9 years [AOR (95% CI) =1.62 (1.06- 2.48)] (Table 3). Those children felling hunger at school were 1.55 times more likely to be thin as children did not fell hunger at school [AOR (95% CI) =1.55 (1.07 -2.23)]. Moreover, the risk of being thin was 1.53 times greater for children from families who did not have latrine than children from families who had latrine [AOR (95% CI) = 1.53(1.09 - 2.13)] (Table 3). On the other hand, being born from older mother >=35 [AOR (95% CI) = 0.70, (0.51 – 0.98) was found to be protective against thinness. The risk of thinness was 30% less for children having mothers of age ≥ 35 than having younger mother. Association of thinness with child's sex was borderline (p=0.05), with the risk of being thin was 1.37 times greater for boys than girls (AOR= 1.35, 95% CI 0.99-1.89).

Discussions

This study demonstrates that the abnormal nutritional status in children and adolescents represents a considerably larger public health problem. The level of thinness which was determined using the newly introduced WHO growth reference 2007 was 11.6 %, and associated with individual and environmental level risk factors. According to WHO Crisis classification of Global Acute Malnutrition (GAM), the prevalence of thinness determined in this study was beyond the acceptable range of less than 5% [18]. Similarly previous studies conducted in different regions of Ethiopia Andrew, Tamiru et al. [7], Mekasha and Zerfu [8], Reji Belay et al. [9], Mekonnen, Tadesse [10], showed that thinness is still a common problem of school-aged children.

Many factors underline the high prevalence of thinness observed

Variable	Number	Percent
Child age (n=1768)		
9-May	541	-30.6
12-Oct	802	-45.4
13-14	425	-24
Gender (n=1768)		
Female	755	-42.7
Male	1013	-57.3
Residence (n=1768)		
Rural	1479	-83.7
Semi urban	289	-16.3
Father education (n=1611)	1135	-68.8
Illiterate/read-write	384	-23.3
Primary	130	-7.9
Secondary and above		
Father occupation (n=1649)	1407	-85.3
Farmer	124	-7.5
Daily laborer	118	-7.2
Government employee		
Maternal age (n=1592)	925	-58.1
24-34	666	-41.9
≥ 35		
Mother's education (n=1592)	1244	-78.1
Illiterate/read-write	348	(21. 9)
Literate		
Mother's occupation (n=1592)	1487	-93.4
Housewife	105	(6. 6)
Working		
Number of living children (n=1768)		
< 4	404	-22.9
≥ 4	1364	-77.1
Wealth status		
Low	724	-41
Medium	548	-31
High	494	-28
Felling hunger at school =1768		
No	1424	-80.5
Yes	344	-19.5
Child illness in the last 2 wk (n=1768)		
No	1605	-90.8
Yes	163	-9.2
Night blindness (n= 1768)		
No	1595	-90.2
Yes	173	-9.8
Bit tot's Spot (n= 1768)		
No	1643	-92.9
Yes	125	-7.1
Water source (n=1768)		
Safe source	1330	-75.2
Unsafe source	437	-24.8
Waste disposal (n=1768)		
Proper	409	-23.5
Improper	1359	-76.5
Toilet (n=1768)		
Improved facility	1230	-69.6
Unimproved facility	538	-30.4

Table 1: Socio-demographic and other selected characteristics of primary school children and their parents, Kersa 2012.

Characteristics	Thinness		Crude OR (95% CI)	Adjusted OR (95% CI)
	Thin	Normal		
Household (basic) factors				
Maternal age (n=1591)	119 (12.9%)	806 (87.1%)	1	1
24-34	70 (10.5%)	596 (89.5%)	(0.79 (0. 58 -1.09)	0.76 (0.55 - 1.05)
≥ 35				
Residence (n= 1768)				1
Rural	169 (11.4)	1310 (88.6%)	0.88 (0. 60-1. 28)	0.95(0.51-1.77)
Semi urban	37 (12.8%)	252 (87. 2 %)	1	
Father education (n= 1649)	138 (12.2%)	996 (87.8%)	1	1
Illiterate/read-write	38 (9.9%)	346 (90.1%)	0. 79 (0.54 -1. 16)	0.67 (0.45-1.02)
primary	19 (14.6%)	85 (85.4%)	1 .23 (0.74 -2.07)	1.29 (0.55- 3.03)
Secondary and above				
Father occupation (n= 1649)			1	1
Farmer	163 (11.6%)	1244 (88.4%)	1.21 (0.75 - 1.95)	1.33(0.66-2.66)
Daily laborer	22 (13.7%)	139 (86.3%)	1. 19 (0. 62 - 2.31)	0.77(0.24-2.42)
Government employee	11 (13.6%)	70 (86.4%)		
Mother's education (n= 1592)			1	1
Illiterate/read-write	147(11.8%)	1097 (88.2%)	1.29 (0.91-1. 83)	1.29(0.87-1.93)
Literate	35(10.1%)	313 (89.9%)		
Mother's occupation (n= 1592)				1
Housewife	177 (11.9%)	1310 (88.1%)	1. 05 (0.56- 1.95)	1.13(0.56-2.27)
Working	12 (11.4%)	93 (88.6%)	1	
Number of children =1768	42(10.4%)	362 (89.6%)	1	1
< 4	164(12.0%)	1200 (88%)	1.77(0.82- 1.69)	0.95(0.51-1.77)
>= 4				
Wealth status			1	1
Poor	121 (12.5%)	850 (87.5%)	0.90 (0.64-1.27)	1.07(0.74-1.54)
Middle	25(12.5%)	175 (87.5%)	0.82 (0. 57- 1.17)	0.85(0.57- 1.25)
Rich	60(10.1%)	534 (89.9%)		
Environmental (Underlying) factors				
Water source	155(11.7%)	1175 (88.3%)	1	1
Protected	51(11.6%)	387 (88. 4%)	0.99 (0.71- 1. 39)	0.97 (0.69-1.36)
Unprotected				
Waste disposal	41(10.0%)	368 (90.0%)	1	1
proper	165(12.1%)	1194 (87.9%)	1.24 (0. 86-1.78)	1.19(0.83-1.73)
open space				
Toilet	130(10.6%)	1100 (89.4%)	1	1
Yes	76 (14.1%)	462 (85.9%)	1.39 (1.01-1. 93)*	1.37(1.01- 1.86)*
No				
Individual (proximate) factors				
Child age (n=1768)	53 (9.8%)	488 (90.2%)	1	1
5-9	91 (11.3%)	711 (88.7%)	1.18(0.82 -1.68)	1.44(0.79-1.64)
10-12	62 (14.6)	363 (85.4%)	1.57(1.06-2.32)	1.56(1.05-2.31)*
13-14				
Sex (n= 1768)	75 (9.9 %)	680 (90.1%)	1	1
Female	131 (12.9%)	882 (87.1%)	1.35 (0.55-1.00)	1.32(0.98- 1.79)
Male				
Felling hunger at school =1768	152 (10.7%)	1272 (89.3%)	1	1
No	54 (15.7%)	290 (84.3%)	1.56 (1.11- 2.18)	1.58(1.23-2.27)*
Yes				
Child sickness in the last 2 weeks= 1768	189(11.8%)	1416(88.2%)	1	1
No	17(10.5%)	145(89.5%)	0.88(0.52-1.48)	0.85(0.50-1.44)
Yes				
Night blindness	179 (11.2%)	141 6 (88.2%)	1	1
No	27 (15.6%)	146 (84.4%)	1.46(0.94- 2.27)	1.46(0.94- 2.27)
Yes				

Table 2: Crude and adjusted measures of the effect of socio-demographic and other related factors on thinness among primary school children in Kersa District, Ethiopia, 2012.

Variables	Categories	COR (95%C.I)	Adjusted OR (95% CI)
Maternal age	24-34	1	1
	≥ 35	(0.79 (0. 58 -1.09)	0.70 (0.51- 0.98)*
Mother's education	Illiterate/read-write	1	1
	Literate	1.29 (0.91-1. 83)	1.32 (0.89 -1.97)
Father education	Illiterate/read-write	1	1
	primary	0. 79 (0.54 -1. 16)	0.74 (0.49-1.11)
	Secondary and above	1 .23 (0.74 -2.07)	1.17 (0.63- 2.18)
Number of children	**< 4**	1	1
	≥ 4	1.77(0.82- 1.69)	1.39 (0.89-2.14)
HH latrine availability	Yes	1	1
	No	1.39 (1.01-1. 93)	1.53 (1.09- 2.13)*
Child age	9-May	1	1
	12-Oct	1.18(0.82 -1.68)	1.09 (0.75 – 1.61)
	13-14	1.57(1.06-2.32)	1.62 (1.06 - 2.48)*
Child Sex	Female	1	1
	Male	1.35 (0.55-1.00)	1.37 (0.99 - 1.89)
Felling hunger at school	**No**	1	1
	Yes	1.56 (1.11- 2.18)	1.55 (1.07- 2.23)*
Child sickness in the last 2 weeks	**No**	1	1
	Yes	0.88(0.52-1.48)	0.91 (0.53-1.57)
Night blindness	**No**	1	1
	Yes	1.46(0.94- 2.27)	1.39 (0.86-2.25)

*=p< 0.05 , COR= Crude Odds Ratio, AOR= Adjusted Odds Ratio.

Table 3: Household, environmental, and individual level predictors of thinness among primary school children (5-14y) in Kersa District, Ethiopia, 2012.

in the present study. Among the individual level factors, child age and feeling hunger at school were significantly associated with children's nutritional status and child sex was marginally associated. The risk of thinness was significantly higher among both boys and girls for older children [11,12] than younger children (5-9 years). An association of age with BMI for Age z-score (thinness) usually describes acute malnutrition has previously been reported by Andrew, Tamiru et al. [7].

The increase in the level of thinness with progressing age found here may be possibly related to the rapid growth of puberty and physical changes that occur during this developmental period may be associated with increased demand for calories and key nutrients. Additionally, as children growing up, they are expected to work outside the home and support family. Thus the level of physical activity, require an increased amount of energy and affect nutrient needs during this period. Failure to consume an adequate diet can result in thinness [19].

Sex differences were also observed in the nutritional status of the children studied. Thinness was more frequent among boys compared to girls indicating that the girls were generally better nourished. This difference can be explained by physical activity habits that require an increased amount of energy and nutrients may contribute to the variations in the prevalence of thinness between genders. At school age, boys showed to be consistently more physically active than girls, both in daily activities and in regular programs of physical exercise and sports, differences that become more pronounced during adolescence. This finding was in consistent with previous studies which reported better nutritional status of female children compared to males [20,21]. Being excessively thin during the school-aged years can lead to delayed pubertal maturation and reduced muscular strength and work capacity [4].

In the present study the risk of thinness was higher among children feeling hunger at school than children who did not feel hunger. This findings can be explained by the fact that, children in the rural areas frequently have to leave home early and walk a considerable distance to school, may miss their morning meal, not get enough of the right things to eat, or be required to work before school and this leads to nutrient deficiencies. These hungry children are more prone to low performance, to be absent from school, to fall sick and to drop out, in addition to having behavioral and attention problems.

In considering environmental level factors, lack of proper waste disposal system and access to safe water did not show any significant association with acute malnutrition among school children in this study. While the risk of being thin was higher among children from families who did not have latrine compared with those that had latrine. Similar results were reported children from families who lack latrine were more likely to be thin [2,4,22]. This finding might be explained by poor sanitation and hygiene interventions can predispose children to intestinal parasitic infections alongside diarrhea, which are believed to be the immediate causes of malnutrition [19,23]. sIn addition environmental enteropathy is caused by repeated fecal contamination which, through an inflammatory response, increases the small intestine's permeability to pathogens while reducing nutrient absorption. Such malabsorption could cause malnutrition of various forms, stunting, and cognitive deficits, even without necessarily manifesting as diarrhea or otherwise observable illness [24,25]. A study report from Bangladesh showed that children who are exposed to more fecal environmental contamination are more likely to exhibit biological markers of enteropathy, and in turn suffered impaired growth [26]. Therefore increasing access to the hygienic sanitation is important to improve the nutritional status of school children.

The effect of the age of the mother at first birth on child nutrition outcomes has been explored in previous studies. It was reported that, children born to mothers who were married below the age of 18 were found at a higher risk of stunting and underweight compared to

children of women who had married at age 18 or older [27,28]. The finding from this study also revealed that children of older mothers (aged ≥ 35 years) had lower prevalence of stunting than children whose mothers were younger. The decreased level of stunting in children of older mothers may be related to maternal experience and adequate child care.

Unlike other studies, among the house hold risk factors of child under nutrition, maternal education was insignificant in this study [29-31]. Lack of association between maternal education and children's nutritional status might be due to the overall educational level of the majority of the mothers (78%) involved in the study were illiterate.

Conclusions

This study provided evidence that over 10% school children were under acute nutritional stress in the form of thinness. Children's age, sex, felling hunger at school and not having toilet at house hold level were factors associated with thinness. Thus, appropriate school health intervention programmes including free school meals which could improve the nutritional status of children should be given priority.

School health implication of the study

Ethiopia is not likely to conduct a nationwide nutritional status assessment of school children and introduce school health and nutrition programmes, although there are efforts to provide school meal at some food insecure districts. Conducting the comprehensive nutritional assessment of school children to capture such an important public health issue is indispensable. A nutritional assessment of this nature is feasible and fairly possible. The survey can identify children in need of nutrition intervention the earliest possible.

Detecting undernourished school children and taking appropriate nutrition intervention can be facilitated by taking anthropometric measurements at school setting. This work will support the aim of the Ethiopian National nutrition program and school health nutrition strategy to improve the quality of life of school children and enable them to stay active longer which can help to enhance productivity and competitiveness. Health and nutrition services that can be readily delivered through schools and close to the children's locality can ensure a healthy future for children.

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Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

FM, YB and AW participated from the conception to the final write up of the study. All authors read and approved the manuscript.

References

1. Sawaya S (2006) "Malnutrition and poor academic performance: critical contributions." Estudos Avancados 20: 133-146.
2. Partnership and FC Development (2002) School-Age Children, their Nutrition and Health Department of Infectious Disease Epidemiology.
3. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, et al. (2007) Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 85: 660-667.
4. Best C, Neufingerl N, van Geel L, van den Briel T, Osendarp S (2010) The nutritional status of school-aged children: why should we care? Food Nutr Bull 31: 400-417.
5. Hassan M (2013) "Anthropometric Measurements and the Effect of Breakfast Sources in School Achievement, Physical Activity and Dietary Intake for 6-13 Years Old Primary School Children Girls in Makkah City." IJNFS 2: 272-279.
6. Intiful FD, Lartey A (2014) Breakfast habits among school children in selected communities in the eastern region of Ghana. Ghana Med J 48: 71-77.
7. Hall A, Kassa T, Demissie T, Degefie T, Lee S (2008) National survey of the health and nutrition of schoolchildren in Ethiopia. Trop Med Int Health 13: 1518-1526.
8. Mekasha A, Zerfu M (2009) Prevalence of anemia among school children in Addis Ababa. Ethiop Med J 47: 129-133.
9. Reji P, Belay G (2011) "Intestinal parasitic infections and malnutrition amongst first-cycle primary schoolchildren in Adama, Ethiopia." Afr J Prm Health Care Fam Med 3-1.
10. Mekonnen H, Tadesse T (2013) "Malnutrition and its Correlates among Rural Primary School Children of Fogera District, Northwest Ethiopia." J Nutr Disorders Ther S12 (002).
11. [No authors listed] (1995) Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser 854: 1-452.
12. WHO Multicentre Growth Reference Study Group (2006) WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development.
13. MOE (2012) National School Health and Nutrition Strategy.
14. Worku N, Erko B, Torben W, Belay M, Kasssu A, et al. (2009) Malnutrition and intestinal parasitic infections in school children of Gondar, North West Ethiopia. Ethiop Med J 47: 9-16.
15. World Bank (2006) Repositioning nutrition as central to development: a strategy for large-scale action. World Bank Nutrition Strategy Paper. Washington, DC: World Bank.
16. Goon DT, Toriola AL, Shaw BS, Amusa LO, Monyeki MA, et al. (2011) Anthropometrically determined nutritional status of urban primary schoolchildren in Makurdi, Nigeria. BMC Public Health 11: 769.
17. Danquah A, Amoah A (2013) "Nutritional Status of Upper Primary School Pupils in a rural setting in Ghana" IJNFS 2: 320-326.
18. World Health Organization (2010) Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide.
19. Checkley W, Buckley G, Gilman RH, Assis AM, Guerrant RL, et al. (2008) Multi-country analysis of the effects of diarrhoea on childhood stunting. Int J Epidemiol 37: 816-830.
20. Wamani H, Tylleskär T, Astrøm AN, Tumwine JK, Peterson S (2004) Mothers' education but not fathers' education, household assets or land ownership is the best predictor of child health inequalities in rural Uganda. Int J Equity Health 3: 9.
21. Kabubo-Mariara J, Ndenge G (2008) "Determinants of Children's Nutritional Status in Kenya: Evidence from Demographic and Health Surveys " Journal of African Economies 18: 363-387.
22. Dean Spears (2013) "The nutritional value of toilets: How much international variation in child height can sanitation explain? Centre for Development Economics." Delhi School of Economics, Delhi, India.
23. Guerrant RL, Oriá RB, Moore SR, Oriá MO, Lima AA (2008) Malnutrition as an enteric infectious disease with long-term effects on child development. Nutr Rev 66: 487-505.
24. Petri WA Jr, Miller M, Binder HJ, Levine MM, Dillingham R, et al. (2008) Enteric infections, diarrhea, and their impact on function and development. J Clin Invest 118: 1277-1290.
25. Dinesh M, Minak J (2011) "Contribution of Enteric Infection, Altered Intestinal Barrier Function, and Maternal Malnutrition to Infant Malnutrition in Bangladesh" Clinical Infectious Diseases.
26. Lin A, Arnold BF, Afreen S, Goto R, Huda TM, et al. (2013) Household environmental conditions are associated with enteropathy and impaired growth in rural Bangladesh. Am J Trop Med Hyg 89: 130-137.
27. Raj A, Saggurti N, Winter M, Labonte A, Decker MR, et al. (2010) The effect of maternal child marriage on morbidity and mortality of children under 5 in India: cross sectional study of a nationally representative sample. BMJ 340: b4258.

28. Kimani-Murage EW, Norris SA, Pettifor JM, Tollman SM, Klipstein-Grobusch K, et al. (2011) Nutritional status and HIV in rural South African children. BMC Pediatr 11: 23.

29. Mukherjee MR, Chaturvedi LCS (2008) "Determinants of Nutritional Status of School Children." MJAFI 64: 227-231.

30. WHO (2006) Child Growth Standards: Report of Regional Workshop. Geneva

31. WHO (2009) WHO AnthroPlus for personal computers Manual: Software for assessing growth of the world's children and adolescents. Geneva.

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