

# Nutritional status of primary school students and its association on academic performance in north-central Ethiopia: Cross-sectional study

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## Research article

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# Abstract

**Background:** Under-nutrition is a fundamental factor which resulted in delayed cognitive development and underachievement of academic performance later in children's life at school. The extent of under-nutrition in Ethiopia has been established well but there are insufficient evidences about its relationship with the educational achievement of school-age children. **Objective :** To assess the correlation of nutritional status with academic performance among public primary school children **Method:** - An institution-based cross-sectional study was conducted over 399 primary school children in Debre-Tabor Town, Amhara Regional State North-Central Ethiopia, 2018 after selecting them with simple random sampling. The nutritional status was assessed using the anthropometric measurement of WHO 2007 reference as Height for Age Z-score (HAZ), Weight for Age Z-score (WAZ) and Body Mass Index for Age Z-score (BAZ). Academic performance was assessed by calculating two semesters of overall subjects' average score. Descriptive statistics, Pearson's correlation test, and linear regression were used for statistical analysis. Data were analyzed using SPSS version 24 and nutritional status was analyzed using WHO AnthroPlus version 1.0.4 (5-19 years). **Result:** - Almost half of study participants were male 209(52%), 291(73%) comes from married family, and 177(44%) were comes from family having more than five members. The mean age of the study participants were 11.85. The prevalence of stunting, wasting, underweight and overweight was 22%, 32.4%, 24.3%, and 1.3% respectively. The prevalence of any form of malnutrition was 56.14% and the mean academic performance for study participants was 71.65(±12.63 SD). There was a statistically significant positive relationship between academic achievement and HAZ. Age of child and absenteeism were associated negatively while attending preschool, the type of head of the house, and having breakfast habits associated positively with the educational achievement of the study participants. **Conclusion:-** The prevalence of under-nutrition among study participants was high. Considering the correlation of absenteeism, skipping breakfast, having preschool education and HAZ, nutritional interventions should be considered at prenatal, infancy and preschool period to sustain positive impact and reducing negative factors. **Key Terms:** Nutritional status, Academic performance, primary school, child1.

## Introduction

Globally the death of 45% under-five children and 38% of early school leaving are attributed to malnutrition. Moreover, there is an estimation of over 450million children will be affected by stunting which is the impact of chronic undernutrition by 2025[1];[2, 3].

Only Africa shares 38% stunted, 27% wasted and 24% overweight children in under-five children. More specifically from 59 million continental prevalence East African region constitutes 24% and aggressively suffering from stunting compared to the West Africa region which was 19.2% (19.2%) [4].

Primary education is an instrument to meet United Nation Education, scientific and Cultural Organization (UNESCO) goal "quality education and lifelong learning for all by 2030" and "end poverty by 2030"[5]. Besides, it is one of the most potent approaches to realize Ethiopia's current Gross Transformation Program (GTP) development vision to become a middle-income economy by 2025 [6]. Progress had achieved over

Millennium Development Goals (MDG) and Education for All (EFA) goals. But, still, 58 million primary school-age children are out of school worldwide due to various reason including nutritional challenges[7].

Ethiopian elementary or primary education is free *with the target of having less than 1% for dropout and repetition rate*[8]. Previously it was indicated that the factors of poor academic performance in primary school children need to be investigated with more powerful design [9]. And also, despite greater demand to improve students' academic performance in developing countries various hampering factors were identified like undernutrition and childrens health status, which adversely affects the ability to learn and poor performance [10, 11]; [12].

Various researches have been consistently describing the impact of well nourishment for its positive effect over intelligence, academic achievements, learning and cognitive performance, maintaining education thereby preserving the nation for the grave effect of malnutrition [13] ; [14]; [15]; [16]. So nutritional intervention is important for children attending primary school since it enhances efforts to reduce levels of malnutrition and supplement better academic achievement in the preschool years.

Malnutrition remains a key crisis in adolescents' school performance due to inappropriate eating practices [11]. Moreover, primary school children who are suffering from malnutrition exhibit underachievement of academic performance with a potential decline in future mental excellence. [17].

Stunting and under-nutrition have immediate and long term effects that range from immediate school dropout to the worse deprivation of growth and development, and subsequent cognition which negatively affects educational achievements[18]; [19].

Various factors of malnutrition like food insecurity, skipping breakfast, overweight, and underweight were shown a strong association with decreased school performance in UK, Brazil, and the USA [16]; [20]; [21]. More specifically, Educational underachievement was seen in 31.5% of obese, 30.0% of underweight and 22.9% of overweight children respectively [22].

Consistently, the USA school breakfast program was proven the increment of academic achievement over program utilizers[21]. Another study also showed Children having frequent breakfast had performed well in IQ test scores while those who occasionally have breakfast perform low [23]. In Zimbabwe, also having frequent meals and taking a regular breakfast, lunch and dinner have show positive effects on children's learning achievement [19].

In addition to underlying nutritional problems, various studies found that boys suffer more from poor educational achievement (23%) than girls (18.6%)[22]; [17]. Another study in Morocco also showed a more profound effect of malnutrition over the boy's school grade average than girls. This study reveals 30.1% of girls and 38.7% of boys rated as poor for mathematics and 17.1% of girls and 37.3% of boys rated as poor to average [11].

Socio-demographic factors including sex, absenteeism, and distance from school, grade attended, parental socio-economic status and parental involvement in their children's schooling were found to be

significantly associated with primary school children's academic performance [24-26].

African malnourished school-age children are at risk of repeating grades and dropping out of school with an achievement of 0.2 to 1.2 years less in school education [27]. Moreover, more than a quarter of children in sub-Saharan Africa are too thin which is resulted in impaired mental development and low educational achievement [25]. By 2025 an additional 11.7 million children will be stunted in sub-Saharan Africa when compared to the 2010 data [1].

Ethiopian Demographic and Health Survey (2016 EDHS) report shows that the prevalence of under-five severe malnutrition was 18% for stunting, 3% for wasting and 7% for underweight respectively [28]. The Cost of Hunger in Africa (COHA) summary report revealed that more than 2 out of every 5 children in Ethiopia are stunted with 16% repetitions in primary school children and achievement of 1.1 years less in schooling [29].

Even though researches done in South Gondar and Goba Town conclude that nutritional status did not show an association with the academic performance [12, 26]. Other pocket studies done in various areas of Ethiopia consistently reporting association and effect of undernutrition over mathematics score [12]; and overall academic performance [25]; [24].

. Like as it was investigated in various developed and developing countries, the effect of nutritional status on the school performance needs to be consistently identified in our context for a convincing planner and diverting potential for intervention since factors differ across various socio-demographic factors. With a diverse role of nurses even as school nurses, the output of this study probably shifts the attention of school nurses for specific nutritional intervention at school level parallel to other routine services and nurses working in policy design for resource and effort mobilization. By far this study benefits the regional education and health office policymakers and zonal planners to intend appropriate nutritional interventions through SFP and NEP at school to deal with the impact of malnutrition on academic performance among primary school children.

## Methods

### Aim, Design, and setting

An institution-based cross-sectional study was conducted from March 30 to April 30, 2018, at Debre Tabor Town, North-Central Ethiopia which is located 665kms north of Addis Ababa The study aims, to assess the association of nutritional status with academic performance. . The 2017 population projection the total population of the town showed 96,973 [30]. The town has two preparatory schools, fourteen elementary schools of which seven governmental, and nine Kindergarten schools. The total population of public primary school children was 6,935 of which 49.14% were males.

### Participants and Sampling

The study was conducted over primary school attending students. Single population proportion formula was used to estimate sample size by considering a 95% confidence level, 0.05 margin of error and average academic performance of 62.25% in the study area [26]. The required sample after adding 10% of the non-response rate was 399. First simple random sampling was used to select three schools from seven schools, and then the proportional allocation of sample to the population size of selected school were employed, and then final systematic random sampling of every nine students were taken as techniques to obtain final study participants after getting complete list of students from each school.

## **Study instrument**

The questionnaire which was originally adapted[12, 26] and prepared in English translated to local language Amharic. The first part of the data collection tool was used to collect information about socio-demographic features with twenty questions. The socio-demographic information helps to describe the character of family in terms of marital status, house head, source of income, economic status, distance of school, history of absenteeism and scape of meal information was inquired.

The second part of the data collection tool was designed to measure nutritional status with body weight. The weighting scale was taken by Prestige digital weight scale [Model: SALTEP weigh-Trony which is British patent 2214320, UK regd Design 1-045-766 and USA regd Design D312585 which was calibrated on 11 July 2000]. It was taken two times independently by two data collectors and an average value was taken for final analysis.

The third part of the data collection tool was height scale, which was measured in meter by data collector while the student stands side to meter posted over the wall. Again this also taken two times by independent data collectors for having average measurements. The fourth part of the data collection tool was the WHO standard Reference guideline, 2007. It was used to interpret and judge measured weight and height during data collection. Accordingly, as HAZ score  $\leq -2SD$  (stunted), WAZ score  $\leq -2SD$  (wasted) and BAZ score  $\leq -2SD$  (underweight) or thin), BAZ  $\geq +1SD$  (overweight) and BAZ  $\geq +2SD$  (obese). The fifth part of the data collection tool was a sheet for measurements of academic performance. It was prepared for recording two consecutive semester student scores from the school roster.

## **Data collection**

Six trained Health extension workers as a data collectors and two trained BSc nurses as supervisors were recruited for the process. Consent was obtained from their parents and informed assent was obtained from children for their authorization to get their anthropometric measurements. The data collection was done in each section of grade by arranging a convenient time and mobilization of measuring equipment. The previous students grades were also obtained from schools record officers. **Data quality control**

The random selection of students, training of data collectors, conducting pretest over 5% of the population and day to day discussion about the progress with supervisors and data collector were activities to maintain the quality of the study. Other measures were using standard tool to measure and

interpret the measurement, and checking of weight scale before each measurements helps to maintain data quality .

## Variables and Measurements

The study uses stunting, underweight and wasting as an indicator of nutritional status among study participants. The children's body weight was measured to the nearest 0.1kg with light clothing and bare foot using a digital weighing scale by trained data collectors. The measurements were taken two times and an average was taken for final analysis. At first and always before the next child the weight measure scale was checked against zero reading. Then the child stood with both feet in the center of the scale. This means that the scale reads zero when no weight is placed on it. Their height was measured using a meter to the nearest 0.1cm without shoes in a standing position. A Child stood on a flat surface with feet flat, together and against the wall. Legs, arms, and shoulders were straight, at sides and level respectively.

**Academic performance** was the dependent variable for this study and operationally measured by taking two semester's average score result of the total subjects obtained from the individual child's semester grade report. Students' grade report cards were taken as a measure of academic performances (Zaini MZ et al., 2005).

**Nutritional status:** is the child's state of the body which is determined by anthropometric measurement indices as stunted, wasted, underweight or overweight based on the WHO standard reference 2007 [31].

**Malnutrition:** is a poor nutritional status of primary school children which is expressed in anthropometric indices when the Z-scores for the WHO standards of 2007 are less than or equal to minus two ( $Z\text{-scores} \leq -2SD$ ) or more than plus one for BAZ ( $z\text{-score} \geq +1 SD$ ).

**Stunting:** indicates the nutritional status of the study participants when their height for age z-score is less than or equal to minus two ( $HAZ \leq -2SD$ ) for the WHO standard reference 2007.

**Well nourished:** indicate children's nutritional status which is measured as HAZ greater than minus two standard deviations ( $HAZ > -2 SD$ ) to the WHO reference 2007.

**Underweight:** indicates the child's nutritional status among the study participants which is measured as body mass index for age z-score less than or equal to minus two ( $BAZ \leq -2SD$ ) of the WHO standard reference 2007.

**Wasting:** is the nutritional status of primary school children aged 7-10 years and expressed in weight for age z-score less than or equal to minus two ( $WAZ \leq -2SD$ ) of the WHO standard reference 2007.

**Overweight:** is the school-age children's nutritional status which is measured in terms of body mass index for age z-score greater than or equal to plus one ( $BAZ \geq +1 SD$ ) of the WHO standard reference 2007.

**Primary school children:** - Children who attend primary school (one to eight grade) and are in the age group of 7-14 years as set by ESDP IV [9].

## Data analysis

Explanatory variables for this study were socio-demographic characteristics of parents, nutritional status of children's, school absenteeism, distance from school and meal pattern, while school performance was the outcome variables for this study.

Data were checked for completeness, coded, entered, cleaned and checked using Epi-Data 3.1 and analyzed using SPSS version 24. The nutritional indicators HAZ, WAZ and BAZ were calculated from measurements using WHO AnthroPlus version 1.0.4 software and compared with the WHO references 2007 data. A descriptive analysis was conducted to get summary data on frequencies, means and standard deviations of the child and their parental socio-demographic and economic characteristic variables. Univariate analysis was used to test for possible association among two variables and multivariate for testing effect of independent variables over outcome variables while the effect other variables were controlled.

Pearson's correlation test was performed to assess the relationship between nutritional status and academic performance of the study participants. Linear regression was performed to identify predictors of academic performance. The statistical significance was declared at P-value  $\leq 0.05$ .

## Results

### Socio-demographic and economic characteristics of the study participants

A total of 399 public primary school children were enrolled with a 100% response rate. Out of these participants, (52%) were males and (48%) were females with a mean age of 12 ( $\pm 1.9$  SD) and 11.8 ( $\pm 1.8$  SD) respectively. The Overall mean of the study participants was Mean 11.85 year. Nearly three fourth of the study participants (73%) were in the age group 11-14. The large proportion of the participants (62%) came from the second cycle (5-8 grades). Almost all of the children were Orthodox Christian (96%) in religion, from urban (99%) and married families (73%). The majority of the participants, (42%) were headed by both father and mother. More than half of the participants, 56% were from a family size of less than five.

The majority of the study participants were born from no formal education mothers (45%), government employee fathers (37%), monthly income of >2000 ETB (62%) and house wife mothers (55.4%). Only half of the study participants, 55% have attended preschool. Regarding breakfast, almost all of the participants (97%) ate breakfast and more than half, 55% of them ate breakfast always. Most of the participants, 97% travels for less than 30 minutes to go to school with an average time of 14.4minute ( $\pm 8.4$  SD) for males and 15.3minute ( $\pm 8.8$  SD) for females respectively. Most of the participants, (71%) were absent from school and 86% of them absent from the school for less than 5 days. (Table 1)

**Table 1:- Socio-demographic and economic characteristics of study participants in Debre-Tabor Town, North-Central Ethiopia, 2018, (N=399).**

Characteristics	Categories	Frequency	Percent
	Grade	2nd- 4th	153
	5th- 8th	246	62
Age	7-10	107	27
	11-14	292	73
Sex	Male	209	52
	Female	190	48
Religion	Orthodox	383	96
	Other	16	4
Marital status of a family	Married	291	73
	Divorced	85	21
	Widowed	7	2
	Other	16	4
Head of house	Father	129	32
	Mother	88	22
	Both	167	42
	Other	14	4
Total family member	< 5	222	56
	> 5	177	44
Place of residence	Urban	396	99
	rural	3	1
Child living with	Father	32	8
	Mother	82	21
	Both	264	66
	Other	20	5
Mother's education	No formal education	178	45
	Primary	106	27
	Secondary	57	14
	College	51	13
	Other	7	1
Occupation of father	Farmer	29	7
	Government employee	147	37
	Nongovernment employee	13	3
	Self-employed	133	33
	Daily laborer	53	13
	Other	24	6
Monthly income of a family	< 1000 ETB	62	16
	1000- 2000 ETB	91	23
	> 2000 ETB	246	62
Occupation of mother	Housewife	221	55.4
	Government employee	60	15
	Daily laborer	37	9.3
	Self employed	73	18.3
	Other	8	2
Child attends preschool	Yes	218	55
	No	181	45
Workload at home	Yes	40	10



	No	359	90
Family support	Yes	322	81
	No	77	19
Breakfast habit	Yes	386	97
	No	13	3
Breakfast eating frequency n= 386	Always	212	55
	Sometimes	174	45
Time taking to school	< 30 minutes	389	97
	> 30 minutes	10	3
Absenteeism	Yes	285	71
	No	114	29
Number of absenteeism days n= 285	< 5 days	246	86
	5 days	13	5
	> 5 days	26	9

### Nutritional status of primary school children

The anthropometric assessment of the study participants revealed that the overall prevalence of any form of malnutrition was 56.14%. Out of this, 88 (22%) were stunted, 34 (32.4%) wasted, 97 (24.3%) underweight and 5 (1.3%) overweight. (See Table 2)

**Table 2:-The prevalence of stunting, wasting, underweight and overweight of study participants in Debre-Tabor Town, North -Central Ethiopia, 2018, (N=399 for HAZ & BAZ, N=105 for WAZ).**

Nutritional indicator	Frequency	Percent
Wasting	34	32.4
Stunting	88	22
Underweight	97	24.3
Overweight	5	1.3

### Academic performance of primary school children

The mean academic performance for primary school children was 71.65 ( $\pm 12.63$ SD) and the female 71.24 ( $\pm 13.73$  SD) performance was slightly less than male 72.02 ( $\pm 11.57$  SD). Study participants in the age group 7-10 perform well (76.61 $\pm$ 11.81SD) academically when compared with those 11-14 years (69.84 $\pm$ 12.45 SD). Children from high monthly income parents performed better (72.91 $\pm$ 12.34 SD) than those from low (69.53 $\pm$ 14.46 SD) income parents. Educational achievement was poor for those who absent for more than five days (69.42 $\pm$ 12.61 SD) when compared to those absent for five days (73.34 $\pm$ 12.21 SD). Children who were overweight perform better (73.70 $\pm$ 9.75 SD) academically when compared with those underweight (70.87 $\pm$ 15.84 SD). Well-nourished children perform better (72.22 $\pm$ 13.05 SD) academically when compared with stunted children (69.65 $\pm$ 11.18 SD). Study participants who ate breakfast sometimes (70.04 $\pm$ 13.54) perform slightly less than those at always (72.54 $\pm$ 11.36 SD). (See Table 3)

**Table 3:- Descriptive result for academic achievement of study participants in Debre-Tabor Town, Amhara Regional State, North-Central Ethiopia, 2018, (N= 399).**

Variable	Category	Mean	Standard Deviation	Frequency	Percent	Minimum	Maximum	95% CI	
								Lower Bound	Upper Bound
Age	7-10	76.61	11.81	107	27	49	97	90	125
	11-14	69.84	12.45	292	73	6	97	274	309
Sex	Male	72.02	11.57	209	52	48	97	189	228
	Female	71.24	13.73	190	48	6	97	171	210
Monthly income	< 1000	69.53	14.46	62	16	6	97	49	77
	> 2000	72.91	12.34	246	62	7	97	227	265
Child attends preschool	Yes	73.60	10.99	218	55	49	97	198	237
	No	69.31	14.04	181	45	6	97	162	201
Family support	Yes	72.13	12.83	322	81	6	97	306	337
	No	69.65	11.66	77	19	49	94	62	93
Eating frequency	Always	72.54	11.36	212	55	47	97	193	231
	Sometimes	70.04	13.54	174	45	6	97	155	193
Absenteeism	Yes	70.81	12.50	285	71	6	97	267	302
	No	73.77	12.76	114	29	49	97	97	132
Number of absenteeism days	5 days	73.34	12.21	13	5	57	90	7	21
	> 5 days	69.42	12.61	26	9	52	90	18	37
Height for age z-score	Stunted	69.65	11.18	66	17	50	94	52	81
	Well nourished	72.22	13.05	311	78	6	97	294	326
Body mass index for age z-score	Underweight	70.87	15.84	73	18	6	97	59	89
	Overweight	73.70	9.75	5	1	58	83	2	11

### Relationship between nutritional status and academic performance

There was a statistically significant positive relationship between academic achievement and the HAZ of the study participants. This positive relationship indicates that as children become well-nourished their height for age z-score increases positively to the appropriate growth and development stage. This, in turn, resulted with enhanced educational achievement(See Table 4)

**Table 4:-Pearson Correlation between nutritional indicators and academic performance of study participants in Debre-Tabor Town, Amhara Regional State, North-Central Ethiopia, 2018, (N=399).**

Nutritional Indicators	Academic performance Average semesters score	
	Pearson's coefficient (r)	P-value
Height-for-age (HAZ)	0.130**	0.009
Weight-for-age (WAZ)	0.097	0.323
Body mass index -for-age (BAZ)	0.000	1.000

\*\* . Correlation is significant at the 0.01 level (2-tailed).

### Socio-demographic predicting factors of academic performance

In the bivariate linear regression model, variables including head of the house, occupation of father, age of a child, grade attended by by child, child attending preschool, breakfast habit, absenteeism, and monthly income were significantly associated with the academic performance of school-age children. After controlling confounding factors in the multiple linear regression model, age of the child, head of the house, attending preschool, breakfast habit and absenteeism were only variables that significantly associated with the educational achievement of the school-age children. Age of the child and absenteeism were variables that have a statistically significant negative association. Variables including head of the house, attending preschool and breakfast habits have a statistically significant positive association with educational achievement. An increase of child age by a unit of year decreases mean academic score by 5.07 (B= -5.07, 95.0% CI: -7.86, -2.28). As students shift their habit from not eating breakfast to eating their academic score improved by 7.61 (B=7.61, 95.0% CI: 0.97, 14.24). Again, as student committed absenteeism their academic score decreased by 3.89 (B= -3.89, 95.0% CI: -6.55, -1.25). Being preschool attendant increases academic achievement by 3.03 (B= 3.03, 95.0% CI: 0.53, 5.52) and being father for head of house increases academic performance by 4.52 (B= 4.52, 95.0% CI: 1.95, 7.09). (Table 5)

**Table 5:-Factors associated with academic performance of study participants in Debre-Tabor Town, Amhara Regional State, North-Central Ethiopia, 2018, (N= 399).**

Variable	Category	B(95.0% CI)	t-test	P-value
	(Constant)	67.18 (59.37,74.99)	16.91	0.000
Age	7-10 year	1		
	11-14 years	-5.07 (-7.86, -2.28)	-3.69	0.000
Head of house	Father	4.52 (1.95, 7.09)	3.45	0.001
	Mother	1		
Breakfast habit	Yes	7.61 (0.97,14.24)	2.25	0.025
	No	1		
Absenteeism	Yes	-3.89 (-6.55, -1.25)	-2.89	0.004
	No	1		
Attending preschool	Yes	3.03 (0.53, 5.52)	2.38	0.018
	No	1		

## Discussion

This study attempted to assess the association of nutritional status with academic performance and to determine the socio-demographic and economic predictors of academic performance among public primary school children in Debre-Tabor Town, Amhara regional state North-Central Ethiopia.

The overall prevalence of any form of malnutrition for the current study was 56% which is higher than the finding of Hawa Gelan in 2017 in Oromia, Ethiopia (34.6%) [25]. However, this finding is less than the finding in Sri Lanka in 2015 (60.2%) [17]. This variation could be due to a difference in the two countries' socio-economic differences.

The finding of this study revealed that the prevalence of stunting was 22% which is higher than a finding from Oromia, Ethiopia (20.6%), Harar, Ethiopia (8.9%), Adama, Ethiopia (15.6%), India (18.5%) and Brazil (1.7%) [20, 25, 32-34]. On contrary, this finding was less than the findings of Fogera, Ethiopia (37.2%), Kenya (24.5%), Egypt (53.2%) and Lambani, India (37%) [15, 35-37]. The higher prevalence of stunting could be early life malnutrition in the young infant period which is a sensitive period for nutrient deficiencies. This disparity could be due to a difference in the composition of diets with essential nutrients like proteins, carbohydrates, fats, vitamins and minerals. These macro and micronutrients are vital for body makeup, immunity and cognitive development of children.

The prevalence of wasting in this study was 32.4% which was almost similar to a finding in India (33.3%) [38]. However, this finding was higher than a finding in Fogera, Ethiopia (30.7%), Hawa Gelan in Oromia, Ethiopia (12.7%), Sidama, Ethiopia (28.2%) and that of Kenya (9.7%) [25, 35, 36, 39]. The finding of wasting in this study was lesser when compared with a finding in Sri Lanka (50.4%) [17]. The discrepancy in acute malnutrition might be due to a difference in children's health status, nutrient composition (balanced diet), diet size and frequencies of the meal. Acute conditions like diarrhea and upper respiratory problems are also key factors for children's acute malnutrition since it reduces their appetite and impede their immunity.

Again in this study, the prevalence of underweight was 24.3% which was almost similar to a finding in Bahir Dar, Ethiopia (24.8%) and the regional state of the study area (24%) [28, 40]. This finding was higher than the findings in Adama, Ethiopia (21.3%), Oromia, Ethiopia (14.2%), Kenya (14.9%) and that of Lambani, India (14.66%) [15, 25, 33, 35]. On contrary, this finding was lesser than findings in Fogera, Ethiopia (59.7%) and Sri Lanka (33.7%) [17, 36]. The inconsistency might be due to differences in socio-economic status and cultural beliefs about foods. Children from rural areas are more at risk for malnutrition than urban children. Additionally meal frequencies affect children's nutritional status in which children having regular meals at morning, lunch and night will have better status than those having any of the three meals.

The prevalence of overweight in this study was 1.3%. This result is less than a finding in Adama in 2016, Ethiopia (3.3%), Nigeria in 2013 (37%), Malaysia in 2014 (18.1%) and that of Brazil in 2014 (22%) [20, 33, 41, 42]. This disparity might be due to variations in individual nutrient intake and food preferences. Also,

differences in socio-economic status could be the reason as Ethiopia is a lower-income country. Lower income countries are at risk of food insecurity which affects children's diet composition, diet size, and frequency of meal.

For the current study, the mean academic performance for study participants were ( $71.65 \pm 12.63$  SD) which is a higher achievement when compared with a study done in Hawa Gelan in Oromia, Ethiopia ( $67.2\% \pm 15.4\%$  SD), Tach-Gaynt, South Gondar, Ethiopia ( $62.25\%$ ), Hawassa, Ethiopia ( $35.1 \pm 4.1$ SD), Sri Lanka in 2015 ( $<40\%$ ) and Nigeria ( $66.19 \pm 17.00$  SD) [17, 25, 26, 43, 44]. The variation could be the difference in the assessment of academic performance, learning methods, learning resources accessibility, tutors given and grading or scoring systems. In this study males perform better ( $72.02 \pm 11.57$  SD) academically when compared with female students ( $71.24 \pm 13.73$  SD). This finding is consistent with a research finding in North-Central and South Central Ethiopian that males have performed 2.39 times better than females in academic performances [24, 26]. In contrary findings in Nigeria, Morocco, India and Asia, revealed that girls have better educational performance than boys [11, 17, 22, 43]. It may be related to the social status of females in the community and recognition of their learning. Moreover, the lack of role model and a high percent of students were not passing through preschool training may contribute to the disparities.

In this study, primary school children from high monthly income parents performed better ( $72.91 \pm 12.34$  SD) than those from low ( $69.53 \pm 14.46$  SD) income parents. Educational achievement was poor for those who absent for more than five days ( $69.42 \pm 12.61$ SD) when compared to those absent for five days ( $73.43 \pm 12.21$  SD). Children who were overweight perform better ( $73.70 \pm 9.75$  SD) academically when compared with those underweight ( $70.87 \pm 15.84$  SD). Well-nourished children perform better ( $72.22 \pm 13.05$  SD) academically when compared with stunted children ( $69.65 \pm 11.18$  SD). Study participants who ate breakfast sometimes perform poorly ( $70.04 \pm 13.54$  SD) when compared with those ate always ( $72.54 \pm 11.36$  SD). Students in the age group 7-10 perform well ( $76.61 \pm 11.81$ SD) academically when compared with those 11-14 years ( $69.84 \pm 12.45$  SD).

The result of this finding shows that there was a statistically significant positive relationship between HAZ and academic achievement ( $p\text{-value}=0.009$ ) which is in line with the finding done in Goba town and Hawa Gelan in Oromia, Ethiopia and Sri Lanka [12, 17, 25]. It is also consistent with a finding in Morocco in 2016 [11]. This indicates that as children become well-nourished their height for age z-score increases to the appropriate growth and development stage which in turn resulted in positive educational achievement.

In the current analysis, WAZ and BAZ did not show a statistically significant relationship with the academic performance of the study participants which is consistent with a finding in various areas of Ethiopian: Tach-Gynt, South Gondar; Gurage Zone; and Goba town [12, 24, 26]. However, this is not consistent with the finding in Oromia, Ethiopia and Sri Lanka in which both WAZ and BAZ had significant positive associations with learning achievement [17, 25]. Even though, it is beyond the scope of this study the discrepancy could be variation in nutrients taken by children which may have either synergistic or

antagonistic effects with each other. At this point, this finding sought a more powerful study design that can indicate a causal relationship among factors.

In this study age of child and absenteeism have a statistically significant negative association with educational achievement. Predictors including head of the house, attending preschool and breakfast habit associated positively with the educational achievement of the school-age children. In this study monthly income did not show significant association with the academic performance which is opposing to Hawa Gelan finding that study participant from high monthly income households perform 2.85 times better than those from low monthly income households [25]. In this study breakfast habits and attending preschool were significantly positively associated with academic performance. This finding is conflicting to the finding in Goba town, Oromia that breakfast habits and attending preschool did not show significant association [12]. Variables including sex of the child, residence, maternal education, paternal education, parental occupation, and family size were not significantly associated with an academic performance which is parallel to the finding of Goba town in Oromia, Ethiopia [12]. Absenteeism was significantly associated with school-age children's academic performance which is parallel to the finding of Tach-Gynt in South Gonar, Ethiopia [26].

This study revealed that as the age of child increases by a unit of year in children aged 11-14 years their educational achievement decreases by 5.07 when compared to those aged 7-10 years (B: -5.07, 95% CI: -7.86, -2.28). These variations could be due to more attention for pubertal period changes rather than learning and attending classes as age increases from 7-10 years to 11-14 years. Adolescence is a period where secondary physiological characteristics are seen which occupied children's attention not to focus on learning and attending classes. The academic performance of study participants who have eaten breakfast increases by 7.61 unit change when compared with those who have not eaten breakfast (B: 7.61, 95% CI: 0.97, 14.24). This could be the positive effect of breakfast as it replaces energy loss in children who spent most of their time on different recreational activities. It also makes students alert and active to learn, participate and attend classes. A unit changes in absenteeism decreases the academic performance of students by 3.89 when compared to those who have not absent (B: -3.89, 95% CI: -6.55, -1.25). This could be due to the negative effect of absenteeism in which students miss important opportunities like lectures and class exercise solutions from their teachers, group discussions with their classmates and other school populations.

Attending preschool enhances academic performance by 3.03 unit change when compared with those who didn't attend preschool (B: 3.03, 95% CI: 0.53, 5.52). This might be the opportunity that children who have attended preschool could have better awareness about the school environment, enhanced communication skill and better social interaction which prepared them for learning and attending class.

## **STRENGTHS AND LIMITATIONS OF THE STUDY**

Using a wider range of student class grades from two to eight and a large sample size can be taken as strength of this study. But, this study was confined to public schools, *as a result, it may decrease confidence about all students in the study area since significant number of students were attending*

*education in private schools. This study also fails to provide evidence about the causal relationship and only limited to the description of a possible association. Moreover, it would have been better and more powerful if the study was incorporated measurements of biochemical parameters in addition to anthropometric measurements that may help to describe and rationalize some of the discrepancies with other studies. Using of reported age without conformation may also limit the strength of the evidence A limited number of variables under study may not show the whole factor of school performance and the absence of follow-up and control group also decrease the power of analysis. Furthermore, other factors of poor academic performance like peer influence, teaching style, and teacher factors were not also considered in this study which can also be taken as a limitation.*

## **Conclusions**

The present study revealed that the prevalence of under-nutrition among school-age children is high in the study area with a large overall prevalence of malnutrition. The prevalence for each nutritional indicator was 22% for stunting, 32.4% for wasting, 24.3% for underweight and 1.3% for overweight. The mean academic performance of the study participants was  $71.65 \pm 12.63$  SD. A significant positive relationship was seen between HAZ and the academic achievement of the study participants. In this study age of the child, head of the house, attending preschool, breakfast habit and absenteeism were variables that significantly associated with the educational achievement of the study participants.

Recommendations: The zonal health and education bureau should work in collaboration with other organizations (NGOs) to combat malnutrition and to strengthen the positive effect of nutrition on the educational achievement of primary school children. The school teachers should encourage students to have breakfast, attend class attentively, motivate female students and create the opportunity to discuss with family about student status.

We also recommend researchers to conduct a further study with a strong study design to investigate the true relationship between nutritional status and academic achievement of school-age children.

## **Abbreviations**

BAZ: Body Mass Index for Age Z-score; EDHS: Ethiopian Demographic Health Survey; EFA: Education for All; ESDP: Education Sector Development Program; GTP: Growth and Transformation Program; HAZ: Height for Age Z-score; IQ: Intelligence Quotient; MDG: Millennium Development Goals; NGOs: Non-Governmental Organizations; NEP: Nutrition Education Program; SBP: School Breakfast Program; UN: United Nation; UNICEF: United Nations Children's Fund; USDA: United States Department of Agriculture; UNESCO: United Nations, Educational, Scientific and Cultural Organization; WAZ: Weight for Age Z-score

## **Declarations**

### **Ethical clearance and consent for participation**

Ethical clearance was obtained from Addis Ababa University school of Nursing and midwifery Ethical committee with Rf No aau/chs/chsg14/2018 on February 07/2018. A formal written letter was given to Debre-Tabor Town Education Sector, Health bureau and to the respective primary schools and health centers. Then a written consent was obtained from the parents of the participant children and informed assent was obtained from children for their authorization to get their anthropometric measurements. Codes were given to the study participants in order to keep their confidentiality.

### **Consent for publication**

Not applicable

### **Competing interest**

The authors declare that they have no competing interest

TE: contribute to conception, design write the proposal, participate in data collection supervision, and analyze the data. FA: had revised the proposal, participate in data collection and research reports. DG: had revised the proposal, participate in data collection and research reports. AA: had revised the design, the proposal, and research report and prepare the manuscript. DT: had revised the proposal and research report. All authors read and approved the final manuscript.

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