

# Adolescents Nutritional Status and its association with Academic Performance in South Ethiopia; a facility-based cross-sectional study

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## Research article

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# Abstract

## Background

Though evidence about the magnitude of malnutrition is well established in Ethiopia, the evidence is scarce about the association of nutritional status with academic performance among adolescents. Thus, this study aimed at determining the association of nutritional status with academic performance among adolescents attending secondary schools in Wolaita Sodo town, Southern Ethiopia.

## Methods

A facility-based cross-sectional study was conducted among 670 systematically selected adolescents in secondary schools of Wolaita Sodo town from April to June 2019. The academic performance of the adolescents was measured using the average mark score of two consecutive semester's results of the overall subjects. Data were analyzed with STATA software Version 15. Descriptive statistics, Pearson Correlation, and linear regression were used in the statistical analysis, and *p-value* < 0.05 was considered as statistically significant.

## Results

The mean academic performance of students was  $69.21 \pm 0.42$  (95% CI: 68.34%-70.02%). An average mark score of students increased by 1.89 ( $\beta = 1.89$ ; 95%CI: 1.14, 2.64) for a unit increase in BMI for age z-score. Being female decreased an average mark score by 2.63 ( $\beta = -2.63$ ; 95%CI: -4.28, -0.98) and being from a separated parents decreased by 4.73 ( $\beta = -4.73$ ; 95%CI: -6.73, -2.74). An average mark score of students from the lowest wealth class decreased by 9.92 ( $\beta = -9.92$ ; 95%CI: -12.79, -7.04) as compared to students from the highest wealth class. Attending private schools increased the average mark score of students by 4.18 ( $\beta = 4.18$ ; 95%CI: 2.46, 5.90).

## Conclusion

Interventions targeted at adolescents' nutritional status should be designed and implemented. The town education office and concerned bodies should launch a school feeding program for government schools. Development and income-generating activities should target households with the lowest wealth status. Schools should give tutorial classes for female students.

## Background

Nutritional status is one of the main factors that could affect academic achievement by limiting students' ability to learn [1]. Undernutrition can inhibit growth, retards mental development, and reduces motivation and educational attainments [2]. Obesity/overweight also has the potential to impair academic performance via social pathways such as discrimination and stigma [3].

One of the vulnerable stages of life is adolescence, where nutrient needs are greater than that in infancy or childhood [4]. Malnutrition during adolescence adversely affects intellectual development, school attendance, growth, health, and academic performance [5]. The adolescent stage comprises one-sixth of the world's population; of which over 90% live in sub-Saharan Africa, and South and Southeast Asia [6]. Ensuring that adolescents can successfully pass this phase of life will help to break the cycle of poverty and produce benefits for individuals, communities, and nations [7].

Despite the economic growth observed in developing countries, undernutrition is still highly prevalent and overnutrition is also becoming a public health concern [8]. According to the Global School-Based Student Health Survey, the mean BMI estimates for adolescents in South Asia, Southeast Asia, East Africa, West Africa, and Central Africa were <20. The lowest BMIs were seen in Ethiopia, Niger, Senegal, India, Bangladesh, Myanmar, and Cambodia [9]. On the other hand, globally, 10% of adolescents are overweight with the prevalence of obesity varying between 2-3%. The prevalence varies from 10% in Africa and Asia to more than 20% in the United States of America (USA) and Europe [10].

Globally, the academic performance of students is declining. Students in sub-Saharan African countries have learned less than half of what is expected and according to the World Bank report, students' academic achievement in Ethiopia is also low [11, 12]. Academic performance might also be affected by other factors like the wealth status of the parents, type of school, parents' educational level, and occupational status.

Several studies were conducted on the magnitude and consequences of nutritional status. However, the association of nutritional status with academic performance among adolescents was inadequately addressed in Ethiopia. Thus, this study aims to assess the association of nutritional status with academic performance among adolescents attending secondary schools in Wolaita Sodo town, South Ethiopia.

## **Methods**

### **Study setting**

Wolaita Sodo town is the administrative capital for the Wolaita zonal administration in South Ethiopia located at 380 km south from Addis Ababa. The town has 3 sub-cities; 11 lower administrative units and the total population is estimated to be 182,607; 49% were female. Common staple foods in the area are cereals, roots, tubers, and vegetables.

Seven government and two private schools deliver secondary education to the population in the town and the surrounding areas.

### **Study design and period**

We conducted a facility-based cross-sectional study involving adolescents in secondary schools from April to June in 2019.

# Population and sampling

The source population was all adolescents in secondary schools in Sodo town. Systematically selected 670 adolescents were studied. Pregnant adolescent girls were excluded. A sample size of 670 was calculated with the following assumptions; 95% confidence level, 5% margin of error, an estimated magnitude of 72.8% taken from a similar study in Ethiopia [13], design effect of 2 and 10% non-response rate. The schools in the town were stratified into government and private by assuming socio-economic differences among the students. One private and three government schools were selected randomly and the sample size was proportionally allocated for each school based on the number of students enrolled. The study participants were recruited using Systematic sampling.

## Variables

### Outcome

The academic performance of the students was an outcome measure. It was measured by totalling students' average mark score of the overall subjects of the last two consecutive semesters.

### Exposure variables and covariates

#### Socio-economic and socio-demographic

Age, Sex of adolescent, marital status of parents, Education and occupation status of parents, and Wealth status.

#### Nutritional status indices:

**Thinness**- is BMI for age z-score (BAZ) of  $< -2$  standard deviation (SD) on the WHO growth reference cut-off point [14].

**Overweight**- was computed with BMI for age z-score (BAZ) of  $> + 1$  SD on the WHO growth reference cut-off point [14].

**Obesity**- was computed with BMI for age z-score (BAZ) of  $> + 2$  SD z-score based on the WHO reference cut-off point [14].

**Stunting**- is the height for age z-score (HAZ) of  $< -2$  SD on the WHO growth reference cut-off point [14].

#### Dietary diversity score

Dietary diversity was determined by using the dietary diversity score (DDS). Dietary diversity score was done based on three non-consecutive days 24-h recall of adolescent consumption of commonly consumed foods in the area [15]. Foods were categorized into 10 groups based on FAO recommendations; (1) starch staple food, (2) vegetables, (3) fruits, (4) meat, (5) egg, (6) fish and other seafood, (7) legumes, nuts and seeds, (8) milk and milk products, (9) oil and fats, (10) sweets, spices,

condiments and beverage [16]. The response categories were "Yes" if at least one food item in the group was consumed and "No" when a food item in the group was not consumed. The results were summed and classified into  $\leq 4$  food items and  $> 4$  food items [17].

## **Behavioral factors**

alcohol consumption, the purpose of spending much time on the internet, and absenteeism.

## **Data collection**

A structured interviewer-administered questionnaire was adopted from relevant articles and related literature [18]. The questionnaire was pre-tested on 5% of the respondents who were later not included in the main study. Four data collectors and two supervisors were trained for two days on different modules of the questionnaire, anthropometric measurement, and ethics.

Anthropometric measurements were standardized against an expert measurer for Technical Error of Measurement (TEM). Weight was measured using a portable digital Seca scale. Height was measured a Seca body meter. All measurements were taken three times, and the average was taken. Academic performance and absenteeism data were taken from school records.

## **Statistical analysis**

Data was entered on Epi-Data Version 3.1 and analyzed by using Stata Version 15. Anthropometric data were analyzed using the WHO Anthro-plus software version 1.0.4 and compared with WHO reference [19]. Descriptive statistics were performed for the main variables. Pearson correlation was used to check the relationship between nutritional status and academic performance. We used linear regression analysis to select exposure variables with an association to the outcome. Exposure variables with a *p*-value of less than 0.25 in the bivariate analysis were taken to multivariate linear regression to identify independent predictors for academic performance. A *p*-value  $< 0.05$  was considered for statistical significance and parameter estimates ( $\beta$ ) with 95% CIs were reported.

## **Results**

### **Socio-demographic characteristics**

A total of 670 adolescents participated in this study making the response rate 100%. The mean age of the respondents was  $16.18 \pm 1.66$ . Of the total respondents, 339 (50.60%) were girls. The majority, 545 (81.34%) of the parents were currently married. One hundred eighty-three (27.31%) mothers and 318 (47.46%) fathers of the students completed college or university education. More than one third 233 (34.78%) of the mothers were merchants whereas 284 (42.39%) fathers were government employees. As for the wealth index, 158 (23.58%), of study participants were from the fourth class (Table 1).

Table 1

Socio-demographic and economic characteristics of the students and their parents involved in the study at Wolaita Sodo town in South Ethiopia, June 2019

<b>Variables (<i>n</i> = 670)</b>		<b>Frequency</b>	<b>Percentage</b>
Age in years	10–14	137	20.45
	15–19	533	79.55
Sex	Male	331	49.40
	Female	339	50.60
Current marital status of parents	Married	545	81.34
	Separated	125	18.66
Educational status of mothers	No formal education	57	8.51
	Read and write	134	20.00
	Primary	123	18.36
	Secondary	173	25.82
	College & above	183	27.31
Educational status of fathers	No formal education	21	3.13
	Read and write	83	12.39
	Primary	98	14.63
	Secondary	150	22.39
	College / university completed	318	47.46
Occupational status of the father	Farmer	96	14.33
	Merchant	158	23.58
	Government employer	284	42.39
	Private	115	17.16
	Daily laborer	17	2.54
Occupational status of the mother	House wife	205	30.60
	Merchant	233	34.78
	Government employer	158	23.58
	Private	66	9.85
	Daily laborer	8	1.19

Variables ( <i>n</i> = 670)		Frequency	Percentage
Wealth quintile	Lowest	110	16.42
	Second	136	20.30
	Middle	136	20.30
	Fourth	158	23.58
	Highest	130	19.40
School type	Government	444	66.27
	Private	226	33.73

## Nutritional status, dietary diversity and behavioral factors

The overall prevalence of any form of malnutrition was 29.33%; 6.30% (95% CI: 4.5, 8.5) were thin, 9.70% (95% CI: 7.6, 12.2) overweight, 4.11% (95% CI: 2.8, 5.7) obese, and 9.24% (95% CI: 7.2, 11.4) were stunted. Majority 469 (76.37%) of the adolescents spend their time on the internet for social media and about one-fourth 166 (24.78%) drink alcohol. About 163 (24.33%) adolescents were absent from school in the study academic year. More than half 396 (59%) of the adolescents had a dietary diversity score of  $\leq 4$  food items (Table 2).

Table 2

Nutritional status, dietary diversity and behavioral characteristics of students involved in the study at Wolaita Sodo town in South Ethiopia, June 2019

Variables ( <i>n</i> = 670)		Frequency	Percentage
Nutritional status (BAZ)	Thin	42	6.27
	Normal	535	79.85
	Overweight	65	9.70
	Obese	28	4.18
Dietary diversity	> 4	274	40.90
	$\leq 4$	396	59.10
The purpose of spending time on the internet	For academic purpose	144	23.49
	For social media	469	76.51
Alcohol consumption	Yes	166	24.78
	No	504	75.22
Absenteeism	Yes	163	24.33
	No	507	75.67

# Relationship between nutritional status and academic performance

There was a statistically significant positive relationship between academic achievement and BAZ and HAZ (Table 3).

Table 3  
Relationship between nutritional indicators and academic performance of Adolescents in Wolaita Sodo town in South Ethiopia, June 2019

Nutritional Indicators	Academic performance	
	Pearson coefficient (r)	P-value
Body mass index -for-age z- score (BAZ)	0.2308*	0.01
Height-for-age-z- score (HAZ)	0.1373*	0.01

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

## Proportion and predictors of Academic Performance

The mean academic performance of the students was  $69.21 \pm 11SD$  (95% CI: 68.38%, 70.04%). Being a girl decreased an average score of academic performance by 2.63 ( $\beta=-2.63$ ; 95% CI: -4.274, -0.981). An average mark score of students from separated parents decreased by 4.73 ( $\beta=-4.73$ ; 95% CI: -6.73, -2.73) as compared to students from married parents. Being from the first-class wealth index decreased an average mark score of students by 9.92 ( $\beta=-9.92$ ; 95% CI: -12.79, -7.04). An average mark score of students from a wealth index of second class decreased by 5.66 (-5.663; 95% CI: -8.132, -3.194) as compared to students from the highest wealth class. Attending private schools increased an average mark score of students by 4.18 ( $\beta = 4.18$ ; 95% CI: 2.46, 5.90) compared to their counterparts. BAZ was positively associated with academic performance. A unit increase in BAZ increased an average mark score of students by 1.89 ( $\beta = 1.89$ ; 95% CI: 1.14, 2.64) (Table 4).

Table 4

Predictors of Academic Performance of adolescents in Secondary school at Wolaita Sodo town in South Ethiopia, June 2019

Variable ( <i>n</i> = 670)		Bivariate linear regression		Multivariate linear regression	
		$\beta$	95% CI	$\beta$	95% CI
Age	15–19	2.45	0.40, 4.50	1.44	-0.43, 3.32
Sex	Female	-1.97	-3.62, -0.32	-2.63	-4.27, -0.98
Marital status	Separated	-8.37	-10.41, -6.34	-4.73	-6.73, -2.74
Education status of the mother	Read and write	-2.92	-4.98, -0.85	-1.74	-4.96, 1.49
	Primary	0.30	-1.84, 2.44	0.29	-3.11, 3.68
	Secondary	2.49	0.61, 4.38	-0.19	-3.58, 3.19
	College & above	1.29	-0.57, 3.15	-3.48	-7.28, 0.32
Education status of the father	No formal education	-1.37	-6.13, 3.39	2.50	-2.33, 7.34
	Read and write	-3.60	-6.11, -1.10	1.48	-1.38, 4.34
	Primary	-1.22	-3.57, 1.12	0.79	-1.66, 3.22
	Secondary	0.17	-1.82, 2.16	-0.09	-2.14, 1.94
Occupational status of Mother	Housewife	-1.24	-3.04, 0.55	0.49	-2.11, 3.10
	Merchant	-0.36	-2.10, 1.38	-0.01	-2.44, 2.43
	Private employee	0.93	-1.85, 3.71	0.41	-2.38, 3.21
	Daily laborer	-5.10	-12.73, 2.53	1.83	-5.61, 9.27
Wealth index	First-class	-10.66	-12.7, -8.57	-9.92	-12.79, -7.04
	Second class	-4.11	-6.15, -2.08	-5.66	-8.13, -3.19
	Middle class	2.19	0.14, 4.25	-1.80	-4.08, 0.48
	Fourth class	4.22	2.20, 6.24	-0.62	-2.88, 1.64
School type	Private	5.83	4.13, 7.52	4.18	2.46, 5.90

Variable ( <i>n</i> = 670)		Bivariate linear regression		Multivariate linear regression	
		$\beta$	95% CI	$\beta$	95% CI
The purpose of spending time on the internet	For social media	-2.71	-4.76, -0.67	-1.40	-3.23, 0.42
Alcohol consumption	No	1.79	-0.13, 3.70	-0.03	-1.77, 1.72
DDS	Adequate	3.56	1.89, 5.22	1.01	-0.56, 2.64
Nutritional status	BAZ	2.14	1.46, 2.83	1.89	1.14, 2.64
	HAZ	1.33	0.60, 2.05	1.48	0.72, 2.24

## Discussion

In this study, the mean academic score of students was  $69.21 \pm 11$  (95% CI: 68.34%, 70.02%). This is consistent with a study from Hawa Gelan (Ethiopia) ( $67.2\% \pm 15.4\%$ ) [20]. However, it is higher when compared with a study done in Nigeria ( $53.30 \pm 7.15$ ) [21]. A higher mean score was reported from Debre-Tabor (Northern Ethiopia) ( $71.65 \pm 12.63$ ) [22]. This disparity might be explained by the difference in students' assessment techniques, the curriculum, and resource accessibility.

There was a statistically significant positive association between nutritional status (BAZ) and academic achievement. This finding agrees with studies from Northern and Southeast Ethiopia, where HAZ was associated with students' academic performance [22, 23]. This finding is inconsistent with a study conducted in Meskan District in Southern Ethiopia, where there was no significant association between HAZ and academic performance [24]. It also contradicts a study conducted in North Ethiopia, where BAZ was not associated with students' academic performance [22]. This variation might be due to differences in the study population and sample size.

Consistent with studies conducted in Ethiopia, Kenya and Nigeria, being a girl decreased students' academic performance [25, 26, 27]. The most possible reason could be the higher workload among girls in the household than boys which could affect their time for study. A different finding was reported from Ghana where the academic achievement of girls was significantly higher than boys [28]. This difference might be due to the socio-cultural difference in the study areas.

The findings of the present study indicated that students from separated parents scored significantly lower than those from married parents. This is consistent with studies conducted in Addis Ababa (Ethiopia) and Ghana [29, 30]. Similarly, another study reported that divorce significantly limited students' academic performance [30]. This could be due to psycho-social and financial crises caused by marital instability.

Compared with students from the highest wealth class, being from wealth index first and second classes decreased students' academic performance. This finding is in agreement with studies conducted in Dessie (Northwest Ethiopia) and Hawa Gelan district in Southwest Ethiopia [20, 31]. Similarly, another study from Goba town in Ethiopia depicted that a higher wealth index is associated with better mathematics scores [23]. This might be explained by the enabling environment created by providing educational materials and other resources which could have motivated students.

We have found a significant difference in academic performance among students who attended private and government schools. Attending private school increased an average mark score of students as compared to their counterparts. This finding is in line with a study conducted in Northwest Ethiopia [32]. Similarly, studies from Nigeria and India revealed that students who attended private schools scored better in reading, writing, and mathematics as compared to students from government schools [33, 34]. This might be because private schools are better equipped in library and laboratory facilities than government schools. The monitoring and evaluation activities are perhaps tight in private schools.

### **Limitations**

We have used only anthropomorphic measurements to determine the nutritional status and did not assess the micronutrient status of study participants. Furthermore, the study did not assess the children's IQ test due to a lack of standardized testing systems in Ethiopia which is designed in the country context and culture appropriate enough to detect cognitive changes.

## **Conclusions**

Wolaita Sodo town health office should design interventions targeted at adolescents' nutritional status. The town education office should work in collaboration with health officials, schools, and NGOs to launch a school feeding program for government schools to enhance nutritional status for good academic performance. Microfinance institutions and other development and income-generating activities should target households with the lowest wealth status. Schools should give tutorial classes for female students. We recommend further studies to determine the association of nutritional status with school performance by including the micronutrient status.

## **Abbreviations**

BAZ: BMI for Age Z-score; BMI: Body Mass Index; CI: Confidence Interval; DDS: Dietary Diversity Score; FAO: Food and Agricultural Organization; HAZ: Height for Age Z-score; NGO: Non-Governmental Organization; NORHED: Norwegian Programme for Capacity Development in Higher Education and Research for Development; SD: Standard Deviation; SENUPH: South Ethiopia Network Universities in Public Health; TEM: Technical Error of Measurement; USA: United States of America; WHO: World Health Organization, WSU: Wolaita Sodo University

# Declarations

## **Ethics approval and consent to participate**

Ethical clearance was received from the ethical review committee at the College of Health Sciences and Medicine in Wolaita Sodo University in Ethiopia. The ethical clearance was written to the Wolaita zone Education department and we got permission from this department and its lower administrative structures to conduct the study. Finally, informed written consent was obtained from each participant, and parents/caregivers provided consent on behalf of students less than 18 years of age.

## **Consent for publication-Not applicable**

## **Availability of data and materials**

The datasets analyzed for this study are available with the corresponding author which can be accessed on reasonable request.

## **Competing interests**

The authors declare that they have no competing interests.

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## **Authors' contributions**

SW conceived the study, designed the protocol, coordinated data collection, analyzed the data and interpret findings, and drafted the manuscript. AA contributed to the design, analysis, and interpretation of the findings, and reviewed the manuscript. SK contributed to the design, analysis, interpretation of the findings, reviewed progressive drafts, and proofread the manuscript. All authors read and approved the final version of the manuscript.

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