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Full Length Research Paper

Height, weight, body mass index and learning achievement in Kumi district, East of Uganda

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The objective was to determine the relationship between nutritional status as measured by height-for-age, weight-for-age, body mass index for age (BMI for-age) and learning achievement. A descriptive cross-sectional design was used. The study was conducted in 34 elementary schools in the district of Kumi, east of Uganda. The subjects included a random selection of 1003 children (457 boys and 546 girls) of grade 4, aged 9-15 years. Standard methods were used to determine height and weight. Height-for-age, weight-for-age and BMI were outcome measures from the height and weight measurements. Learning was assessed in English, Mathematics, life skills and verbal comprehension using a non-standardized method, and was based on the curricular objectives designed by the Ministry of Education and Sports (MOES), republic of Uganda. Outcome measures of learning were percentage scores obtained, graded according to the system provided by the MOES. Confounding variables (gender and age) were used to stratify the children and associations between nutritional variables and learning were tested for the different areas of learning ($P < 0.05$). The descriptive results showed significant associations between height, weight, BMI and learning ($p < 0.05$). The associations were positive for mathematics and English but negative for life skills and verbal comprehension. The negative association between the nutritional variables and the latter two can not be explained. Height, weight and BMI have a significant association with learning, suggesting the importance of nutrition in the education system.

Key words: School children, nutritional status, learning achievement.

INTRODUCTION

Historically, analyses aiming at the improvement of accessibility and quality of schooling in countries struggling with educational issues have focused on school related factors such as location, availability of teaching materials, teacher quality and institutional management (Ani and Grantham-McGregor, 1999; Panda, 2001). Demographic and socio-economic characteristics of households are commonly cited as important determinants of school participation and school achievement/outcomes as well (Grantham-McGregor and Walker, 1998). Surprisingly, except for age and gender, individual characteristics such as health and nutritional status are generally overlooked as underlying factors that undermine educational efforts (Pollit, 1990).

Many accounts have been given on the relationship between health and nutritional variables and intellectual development including academic achievement. Among these are several studies on the relationship between undernutrition, wasting, stunting and academic achievement (Cueto, 2005; Ivanovic et al., 2004; Mukudi, 2003; Themane et al., 2003; Ivanovic et al., 1996; Pollit, 1990). All these studies have reported significant findings between nutritional status indicators and cognitive test scores or school performance indicators. Consistently, past and present nutritional status were linked to higher cognitive test scores or better school performance. Taller children were also likely to be enrolled in school earlier than shorter ones. In China for example, height for age (HAZ) was also a predictor of the degree to which a child's grade level was age appropriate. One standard

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deviation (SD) improvement in height represented an increment of 0.3 year “less far behind” in terms of school grade- for- age (Jamison, 1986). Sigman and others (Pollit, 1990) found that Kenyan children who were better nourished had higher composite scores on a test of verbal comprehension and the raven progressive matrices. For the children as a group, the best predictors of cognitive scores were duration of schooling, food intake (current nutrition), physical stature (nutritional history) and socio-economic status. Similarly, Florencio (1990) concluded from her study in the Philippines that the academic performance and mental ability of pupils with good nutritional status were significantly higher than those of pupils with poor nutritional status as a whole, even when family income, school quality, teacher ability or mental ability were controlled. Based on the findings presented in these studies, it appears that malnutrition does alter the processes associated with cognitive function and learning. Passivity, apathy, shortened attention span, reduced short term memory, failure to acclimate to repetitive stimuli are all associated with malnutrition (Levinger, 1996). While it is useful to have a general sense of conditions potentially important for school age children, these conditions vary from region to region within a country and even more so across countries. It is therefore essential in the Ugandan context to obtain as much information as possible to find out if there are any inter-relationships among these variables.

In Uganda, increasing numbers are enrolling in primary school now through the universal primary education program and more marginal populations are gaining access to school through this expanded enrolment. They are more likely to be hampered by nutrition and health problems if they are not attended to. More so, research on the relationship between educational performance and health in general in Uganda has been scarcely reported (e.g. School Health Policy for Uganda, 2005), and in nutritional status in particular, no study has reported its relationship with learning achievement. However, the Uganda Demographic and Health Surveys (UDHS, 2000 - 2001) report poor health indicators for Uganda (as indicated by the child and maternal mortality and morbidity rates), and the health of school children is not any better than the rest of the communities from which they originate (School Health Policy for Uganda, 2005).

The purpose of this research, therefore, was to highlight the relationship between nutritional status as measured by height for age (HAZ), weight for age (WAZ) and body mass index for age (BMI for-age) with learning achievement of rural children in Kumi District (East of Uganda).

METHODS

Design and sampling

The study was conducted in Kumi district, east of Uganda. Kumi district was selected for this study due to the persistent poor educational outcomes in national examinations, high drop-out and repetition rates (Uganda Education Statistics Abstracts MOES, 2005).

The study employed a cross sectional study design. Anthropometry was done at the beginning and final stages of the study, while learning assessments were done over a period of 9 months during the school calendar (February 2006 to Nov 2006). Other studies were being conducted at the same time including micronutrient and health assessment of the children.

The Sample was composed of 1003 children from 34 schools. The schools involved were public mixed (boys and girls) day schools (without boarding facilities), and were sampled using a modification of cluster sampling (WHO method). Modification was done by selecting schools of only one grade level (grade 1). Grade 1 schools (according to the Ministry of Education classification) are schools with enrolment figures greater than 700, meaning that they have the facilities to take care of the high enrolment figures. The choice for these schools was to minimize the effect of school variation on achievement of children, and also to be sure that 30 children could affectively be randomly sampled in the class under investigation. Children in primary 4 were selected to participate based on information that this is a level at which children acquire basic learning competencies (BLC’s) (UNESCO, 2000). Selection of the participants was randomly done after screening them for health problems (like visual impairment, hearing impairment, physical disability, and mental retardation) that are reported to affect their capacity to learn and achieve well (King et al., 1981; Werner, 1987).

Ethical consideration

Ethical clearance for the study was granted by the Uganda National Council of Science and Technology in Kampala-Uganda, after the study protocol had been reviewed by the ethical committee of Makerere university medical school. Written informed consent was then obtained from the parents and guardians/caretakers of the children in class 4. Consent was done at school after the children were requested to inform their parents to come for a special meeting, where the study objectives were clearly explained to them before they could give consent. Permission and clearance to conduct the study in schools was also obtained from the Ministry of Education and Sports (MOES) and from the District Education Office (DEO), who then gave directives to all head teachers in schools where the study was being conducted.

Anthropometric methods and protocols

The anthropometric variables studied included height and weight. Height (nearest 0.1 cm) was measured using a height board (RI Woonsocket, Short productions; New York, USA). Weight (nearest 0.1 kg) was measured using an electronic scale (Tanita Corporation Tokyo Japan, THD-305). Children were measured wearing only school uniform as standard clothing and no shoes. Any extra clothing outside the undergarments had to be removed. All measurements were done before lunch, and the scale was calibrated after every 50th child with a 10 kg weight. No correction was made for undergarment (e.g. pant and peticot) worn.

Measurement of learning achievement

Learning achievement/outcome was measured in four areas of learning including english language (ELA), mathematics (MA), life skills (LSA) and oral/verbal comprehension (ORA) using simple non-standardized tests which were designed to address objectives pursued by curricular programmes of the Ministry of Education. english language and mathematics were assessed by testing the children after they had been taught. Two lessons and assessment

Table 1. The four levels of grading performance of primary school children in Uganda.

Level	Mark range (%)
V. Good/Excellent	80 - 100
Good	60 - 79
Fair	31 - 59
Poor/ weak	0 - 30

Source: Primary school pupils cumulative record card. MOES, Republic of Uganda (unpublished)

Table 2. Descriptive results showing anthropometric measures of children in the study (n = 1003) results are presented as means. Figures in parentheses indicate standard deviations.

Parameter	Boys (n = 457)	Girls (n = 546)
HAZ	-0.66 (1.03)	-0.38 (1.00)
Prevalence of stunting (%)	3.9	2.6
WAZ	-1.04 (0.88)	-0.72 (0.84)
Prevalence of underweight (%)	6.8	4.6
BMI (kg/m^2)	16.29 (1.41)	16.80 (1.99)
Prevalence of thinness (%)	7.6	5.6

Where: Stunting = HAZ< -2 SD;Underweight = WAZ< -2 SD; Thinness = BMI < 5th percentile. *Classifications were assigned based on the growth charts of US Centres for Disease Control and Prevention (CDC/NCHS, 2000).

tests were given in each of the taught subjects and the content taught was determined by identifying the topic that was to come next in the syllabus. The objectives of teaching followed were those designed by the Ministry of Education and Sports, Republic of Uganda. In mathematics, two areas taught and tested included "place values and measures" while in English they included "tenses and grammar". Both mathematics papers were composed of 27 questions, while English comprised of 35 test items, of which the children had to answer all in one and a half hours (90 min). Life skills assessed common knowledge possessed by the children in the five domains of learning (Piaget, 1983). This did not involve teaching, and the paper comprised of a wide array of knowledge from hygiene, nutrition, social, environmental and HIV/AIDS awareness. There were 45 items of which the children had to answer all. Oral/verbal comprehension assessed verbal comprehension of the children, which too did not involve teaching. A text was composed by the English teacher on the theme "money" for the children to read, along with areas of assessment and scores for each of the areas. Examples of some areas assessed included audibility, handling of text, clarity, intonation, language flow, to mention but a few. The outcomes of reading were assessed instantly as the child went through the text.

Confounding variables and outcome modifiers of learning such as variation in teacher quality, hunger level, days of the week, time of the day, methods of measurement, health of children, age and sex were minimized by using only 2 teachers in the teaching and assessment exercise for all the 34 schools, providing breakfast before lessons begin, exemption of Monday and Friday in the program, using only morning hours for the exercise, teaching the same content and administering the same test for all the 34 schools, exemption of those children feeling unwell on the day of testing and stratification of achievement data by age and sex, respectively. The criterion to select the two teachers was based on the overall performance of schools in the district in the previous academic year (2005), in which case teachers from the best school were asked to participate. The learning indicators were assessed as children's abilities to answer correctly what they were required to do (in relation to what they were taught), for example, representing given numbers correctly into their place values on the abacus, construct sentences as taught, read, represent and interpret given content. The outcomes of learning were measured as scores of written and oral/verbal responses that the child obtained correct, subsequently awarded out of a maximum of 100% and were graded based on the system provided by MOES, Uganda (Table 1).

Data handling and analysis

Data on height and weight were analyzed using Epiinfo Version 3.3.2 (Centers for Disease Control and Prevention, Atlanta Ga., USA) to derive nutritional indices HAZ and WAZ that could be used to categorize the children's nutritional status following the assessment criteria of CDC/NCHS (2000). Given the age of the children, WAZ for many of them (>9 years) was not easy to estimate, therefore BMI-for age, which is recommended for use above this age group (CDC/NCHS growth charts 2000), was used. SPSS for windows computer package (Version 11.0) was used to carry out the various tests of interest. Tests of association between nutritional variables and learning achievement were done by use of Pearson correlation coefficient, tests for comparison of means between groups (boys and girls) was done by use of students' t-test. A p-value of 0.05 or less was used as a probability level at which differences were considered significant.

RESULTS

Anthropometric assessment for measure of malnutrition

Table 2 represents the descriptive results of anthropometric characteristics for height, weight, BMI for the children (n = 457 boys; n = 546 girls); ranging from 9 – 15 years (the average age being 12.10). The mean value of HAZ was -0.66 (1.03) and -0.38 (1.00); WAZ was -1.04 (0.88) and -0.72 (0.84), and for BMI 16.29 (1.41) and 16.80 (1.99) for boys and girls, respectively. The mean values indicate that the children were above the cutoff points (according to Gibson, 1990). Overall, the prevalence of stunting (HAZ < -2SD), underweight (WAZ < -2SD) and thinness (BMI < 5th percentile) was higher among boys compared to the girls (Tables 2 and 3). A t-test however revealed that except for thinness, the difference in levels of stunting and underweight in the two groups was not statistically significant ($p < 0.05$).

The prevalence of stunting increased from 1.8 to 19.5% at 10 - 14 years among boys with severe stunting (4.9%) only occurring at 14 years. Among the girls, it increased from 4.3 to 7.5% at 11 - 13 years with severe stunting. (2.3%) occurring at both 12 and 13 years. Underweight among boys increased from 3.6 to 24.4% at 10 - 14 years, while among the girls, levels increased from 6.5 to 13.4% at 11 - 12 years. Thinness among the boys also increased from 9.1 to 24.0% at 10 - 15 years compared

Table 3. Height for age, weight for age and BMI measurements of the children disaggregated by age and sex. Values are presented as means with standard deviations in parentheses.

Age (years)	Sex (n)	HAZ	WAZ	BMI
9	M (7)	-0.11 (0.73)	-0.46 (0.86)	15.28 (1.57)
	F (12)	0.30 (1.04)	-0.20 (0.60)	15.51 (1.26)
10	M (55)	-0.26 (0.97)	-0.55 (0.81)	15.77 (1.27)
	F (63)	-0.01 (0.97)	-0.59 (0.69)	15.63 (1.24)
11	M (80)	-0.37 (0.90)	-0.77 /0.76)	15.97 (1.19)
	F (93)	-0.10 (0.96)	-0.76 (0.78)	15.92 (1.49)
12	M (127)	-0.70 (1.07)	-1.19 (0.84)	15.98 (1.13)
	F (180)	-0.45 (0.93)	-0.88 (0.84)	16.38 (1.50)
13	M (123)	-0.83 (1.00)	-1.21 (0.86)	16.58 (1.52)
	F (121)	-0.65 (0.98)	-0.66 (0.89)	17.75 (2.23)
14	M (41)	-1.03 (1.16)	-1.24 (0.92)	17.21 (1.38)
	F (60)	-0.50 (1.08)	-0.59 (0.88)	18.33 (1.83)
15	M (25)	-0.96 (0.89)	-1.23 (1.00)	17.67 (1.93)
	F(16)	-0.52 (0.91)	-0.69 (0.10)	18.90 (2.18)

to an increase from 3.2 to 12.2% at 10 - 12 years among the girls. Overall therefore, boys were more stunted, underweight and thinner than the girls.

There was increasing prevalence of thinness with increase in age among the boys whereas girls showed a decrease in prevalence of thinness with increase in age among the girls (Table 4).

Educational achievement

Out of the 1003 children who were measured, 998 were able to complete all the six assessments. The overall achievement (for 6 assessments) for the group was 23.80, indicating a lower educational outcome (0 - 30) as measured against Ministry of Education and Sports (MOES-Uganda) standards. Overall achievement showed that only 25.3% of the children obtained above the 30% mark, 0.4% of which scored a good grade (60 - 79) while a majority (74.6%) had poor learning outcomes.

Table 5 shows the levels of performance stratified by sex. It was observed that 27.7% of the boys scored 30% mark and above, compared to 23.2% of the girls. Although practically this shows that male children performed better than female children, the t-test for difference between the two groups revealed that the difference was not statistically significant ($p < 0.05$). In other words, there was no significant difference in performance between boys and girls.

The research question was related to the association between nutritional status as measured by height for age, weight for age, BMI for age and learning achievement. Table 6 shows the relationship between the above nutritional variables with achievement.

The table (Table 6) shows that all nutritional indicators (HAZ, WAZ and BMI) had significant associations with learning achievement of children in the study ($p < 0.05$). Associations were positive particularly for mathematics and English, but negative for life skills and oral comprehension. HAZ showed importance in mathematics only among boys but not girls, WAZ was important in both English and mathematics among girls but in mathematics alone among boys. All the positive associations however, were observed among older children (13 years and above). Compared to the boys, BMI for girls showed a significant positive association with English and mathematics achievement ($p < 0.05$; 0.01 respectively), while it showed negative associations with all areas of learning among boys. This finding is similar to the trend reported on Table 4 which shows that as boys aged, they became thinner than the reference age group while the reverse was true for the girls.

Table 7 shows levels of achievement of stunted, underweight and thin children (boys and girls) in the study. It was observed that these children did not get scores above level 3 (<59%). 74.3, 76.5 and 67.1% of the boys who were stunted, underweight and thin respectively scored between 0 - 30% mark; while 69.2, 76.1 and 76.8% of the stunted, underweight and thin girls respectively scored at the same level.

All children who performed well (scoring above 59% mark) were in categories of HAZ and WAZ >-2 SD. Likewise, children whose BMI for age was below 5^{th} percentile and those at risk of obesity (BMI > 85^{th} percentile) obtained means that were not above 59% and the converse was true for healthy children (BMI < 5^{th} < 85^{th} percentile). This shows that these nutritional indicators indeed have a relation to achievement.

Table 4. Proportion of subjects (percent) that were malnourished and normal in the study, stratified by age and sex. Numbers 1 and 2 represent malnourished (<-2SD) and normal (>-2SD) respectively.

Age			Proportion (by sex)		Proportion (overall)
			m	F	
9	**HAZ by cut off point***	1	0	0	0
		2	36.8	63.2	100
10		1	.8	0	.8
		2	45.8	53.4	99.2
11		1	.6	2.3	2.9
		2	45.7	51.4	97.1
12		1	4.6	2.9	7.5
		2	36.8	55.7	92.5
13		1	5.7	3.7	9.4
		2	44.7	45.9	90.6
14		1	7.9	4.0	11.9
		2	32.7	55.4	88.1
15		1	2.4	2.4	4.9
		2	58.5	36.6	95.1
9	**WAZ by cut off point***	1	0	0	0
		2	36.8	63.2	100
10		1	1.7	0	1.7
		2	44.9	53.4	98.3
11		1	4.0	3.5	7.5
		2	42.2	50.3	92.5
12		1	6.5	7.8	14.3
		2	34.9	50.8	85.7
13		1	10.7	4.1	14.8
		2	39.8	45.5	85.2
14		1	10.9	4.0	14.9
		2	29.7	55.4	85.1
15		1	12.2	7.3	19.5
		2	48.8	31.7	80.5
9	**BMIc by cut off point***	1	10.5	5.3	15.8
		2	26.3	57.9	84.2
10		1	4.2	1.7	5.9
		2	42.4	51.7	94.1
11		1	4.0	6.4	10.4
		2	42.2	47.4	89.6
12		1	7.8	7.2	15.0
		2	33.6	51.5	85.0
13		1	9.8	5.7	15.6
		2	40.6	43.9	84.4
14		1	7.9	4.0	11.9
		2	32.7	55.4	88.1
15		1	14.6	4.9	19.5
		2	46.3	34.1	80.5

*classifications were assigned based on the growth charts of US Centres for Disease Control and Prevention (CDC/NCHS, 2000). Generally, the proportion of malnourished and normal children was higher among older children (14 years and above) compared to the younger ones (Table 4).

Table 5. Levels of educational achievement among boys (n= 455) and girls (n=543) by number and percent

Level of Achievement	Sex	Frequency	Percent
V. Good	Males	0	0
	Females	0	0
Good	Males	2	0.4
	Females	2	0.4
Fair	Males	125	27.3
	Females	124	22.8
Poor	Males	328	71.6
	Females	417	76.8
Total		998	100

Where: V.Good/Excellent = (80-100)
Good = (60-79)
Fair = (31-59)
Poor/Weak = (0-30)

DISCUSSION

Results of the present study demonstrate that learning among children is associated to nutritional factors including their height and weight, and also influenced by their sex and age. The average age of the children who took part in the study (12.10 years) seems to indicate that many of these children either enrolled late, repeated a class one or more times or even temporarily dropped out of school, based on the fact that the Ugandan law requires that by the age of 6 years, children are enrolled in primary 1. By the time of conducting this study at primary 4, these children should have been between 10 and 11 years of age. Health and nutrition of school children has been attributed to influence enrollment, absenteeism and repetition of grades (as reported by Alderman et al., 1996; 2001; UNESCO, 2000; Cueto, 2001; UNICEF, 2002 and many more). There was a general observation that the trend of Z-scores for HAZ, and WAZ decreased with age thus as children got older, they became progressively shorter and underweight, and the boys tended to be more stunted, underweight and thinner than the girls. However, at the onset of puberty (about 13 years), prevalence slowly declined, a finding similar to what has been reported by Stoltzfus et al. (1997), Partnership for Child Development (PCD, 1998) and Shahabuddin et al. (2000). The peaks of prevalence differed for the two groups where boys' prevalence peaked at 14 while girls' prevalence peaked at 12, which may probably reflect delayed onset of puberty among the boys. However, there was consistently an increase in BMI with increase in age.

The importance of sex and age in learning has been revealed in this study, a similar finding reported in Pollit (1990). As a single group of children, HAZ, WAZ and BMI showed no significant association with any of the four areas of learning. Stratified by sex and age, all nutritional variables (HAZ, WAZ and BMI) associated significantly with all the four areas of learning assessed. Taller children (greater height for age), a measure of prior nutrition (Levinger, 1996), has been a found to positively associate with grade level. Taller children have higher levels of verbal development, performance on reading, spelling and arithmetic tests. In this study, HAZ has been found to positively correlate with arithmetic tests (MA), which partly agrees with the above assertion. However, verbal comprehension/reading (ORA) has been found to negatively associate with increase in height, which contradicts the statement above.

Greater weight for height (BMI in this case), known to be an indicator of current nutritional status, has been reported to correlate well with better performance on concentration tests (Levinger, 1996). The trend in the results showed that prevalence of thinness among boys increased with age while it decreased with age among the girls. It is therefore possible that the statistically significant positive association between BMI for age with mathematics and English language among girls but not boys was a result of the decline in thinness as they increased in age compared to the boys. However, gender differentials in behavior but not learning cannot be ruled out, as postulated (Fergusson and Horwood, 1997), who reported that between boys and girls, there are differences in educational outcomes, which cannot be explained by gender differences in intelligence. The higher rates of negative achievement by boys may adequately be explained by gender related differences in classroom behaviors with males being more prone to dis- ruptive and inattentive classroom behaviors that appear to impede male learning and lead to a male educational disadvantage.

To a large extent, significant positive asso-ciations observed between the areas assessed and nutritional indices are seen in the older stages of growth just at the beginning of puberty, which has been similarly reported (Ivanovic et al., 1996). In the early years of their growth, there is high prevalence of stunting, underweight and thinness which have a negative impact on their achievement and conversely as they grow, prevalence rates decline and performance is seen to improve. Most measurements of achievement have been done with standardized methods, and usually a lot of factors interplay within such tests. For example, there are different learning environments in different schools, children come from different socio-economic backgrounds, and they are of different gender, etc. All these do play a very important role in children's achievement. In this study, the use of unstandardized tests that were tailored to what the children were taught in class (as dictated by the curriculum) was an attempt to deal with this problem. In general, the results show a relation-ship between nutritional status (as measured by HAZ, WAZ and BMI) in all

Table 6. Pearson correlation coefficients (r) between nutritional Indicators and learning achievement among the study population.

Anthropometric indicator	Area of learning	r (by sex) (n = 998)		r by age group (years)													
				9		10		11		12		13		14		15	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
WAZ	ELA	.025	.035	-.265	.204	.187	.043	-.045	.000	-.160	.022	.025	.059	-.018	-.038	-.138	.553*
	MA	.032	.089*	-.518	.318	.077	.122	-.056	.040	-.130	.077	.140	.074	.340*	.079	-.195	.620*
	LSA	-.105*	-.023	-.668	.358	.140	-.011	-.193	.040	-.172	.029	-.125	.015	.056	-.259*	.127	-.127
	ORA	-.043	-.028	-.004	.267	-.123	-.029	-.159	-.074	-.198*	-.062	.087	.161	-.153	-.210	-.232	-.426
HAZ	ELA	.029	.005	-.357	.239	.168	-.061	-.125	.001	-.098	-.035	.043	-.070	.037	-.028	.001	.274
	MA	.070	.021	-.613	.143	.022	.006	-.125	.094	.012	.042	.212*	-.051	.383*	-.040	-.204	.257
	LSA	-.074	-.029	-.455	.311	.212	-.035	-.279*	-.003	-.108	.071	-.064	-.050	-.035	-.405**	.197	-.277
	ORA	-.084	-.022	-.065	-.078	-.121	-.242	-.271*	-.080	-.204*	-.100	.047	.151	-.177	-.126	-.168	-.445
BMI	ELA	-.078	-.006	-.182	-.007	.169	.126	.063	.012	-.182*	.063	-.005	.135	-.070	.014	-.193	.539*
	MA	-.042	.088*	-.271	.232	.101	.168	.042	-.036	-.266**	.077	-.023	.126	.107	.211	-.053	.628**
	LSA	-.075	-.026	-.516	.112	.089	-.007	.000	.086	-.204*	-.027	-.135	.052	.117	.048	.032	.055
	ORA	-.056	-.076	.015	.421	-.081	.200	.049	-.010	-.103	.012	.124	.097	-.023	-.158	-.114	-.160

*.Significant at P < 0.05; **. Significant at P < 0.01.
ELA = English language, MA = mathematics, LSA = life skills and ORA = oral/verbal comprehension.

areas of learning, positive for mathematics and english language but negative for life skills and oral/verbal comprehension. Further more, it was shown that these relationships were highly influenced by gender and age, which confirms what is reported by other researchers e.g. Fergusson and Horwood (1997). Being the first study if this kind, it is recommended that other studies be conducted on socio-economic status, nutrition in relation to other areas of learning to see how such factors influence the observed relationships. Since the results show that malnutrition exists among school children, it can also be attributed to the poor educational grades usually obtained by the district at the end of the every year. These results have implications for factors that influence student achievement. While educational planners focus on issues to do with improving standards of education in the country, health officials are also thinking about the ways to ensure survival of young children (less than 5 years). The fate of the schoolchild is not being taken care of, and in the broadest sense, these results provide a place for nutrition considerations for school children at policy level and also at educational planning levels so as to create better academic achievement among them.

Conclusion

In this study, we conclude that, HAZ, WAZ and BMI have an association with learning, which is positive for Mathematics and English but negative with life skills and verbal comprehension among children in Kumi district. Apart from height, weight and body mass index of a child, gender and age have important roles to play in achievement of children. As age increased (13 above), performance was seen to significantly and positively associate with their nutritional status. We do recommend further studies, to better understand the associations between anthropometric variables with life skills and oral achievement, since they both showed negative associations with the nutritional indicators studied.

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Table 7. Levels of achievement by the stunted (HAZ < - 2), underweight (WAZ < - 2) and thin children (BMI < 5th percentile) by number.

Indicator	Levels of performance				
		1	2	3	4
Stunting	M (n = 39)	0	0	10	29
	F (n = 26)	0	0	8	18
Underweight	M (n = 68)	0	0	16	52
	F (n = 46)	0	0	11	35
Thinness	M (n = 76)	0	0	25	51
	F (n = 56)	0	0	13	43

Where 1 = Very good/excellent (80 - 100); 2 = Good (60 - 79); 3 = Fair (31 - 59); 4 = Poor/weak (0 -30).

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