Research Article

Nutritional Status and Educational Performance of School-Aged Children in Lalibela Town Primary Schools, Northern Ethiopia

Muluken Ayalew,¹ Alemayehu Bayray,² Abate Bekele,² and Simegnew Handebo³

¹Lalibela Hospital, Lalibela, Ethiopia
²School of Public Health, College of Health Sciences, Mekelle University, Mekelle, Ethiopia
³Department of Health Education and Behavioral Sciences, College of Medicine and Health Sciences, Institute of Public Health, Gondar University, Gondar, Ethiopia

Correspondence should be addressed to Simegnew Handebo; hsimegnew@yahoo.com

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Background. Every student has the potential to do well in school. Failing to provide good nutrition puts them at risk for missing out on meeting that potential and leads to long-term irreversible damage to cognitive development. However, taking action today to provide healthier choices in schools can help set students up for a successful future full of possibilities. So, this study is aimed at assessing the effect of nutritional status on academic performance of school-aged children.

Methods. A school-based cross-sectional study was conducted from Feb 05- March 30, 2017 in Lalibela town. A total of 505 primary school students were included in the study. The child anthropometric measures were calculated using AnthroPlus software version 1.0.4 WHO 2007 standards. Bivariable and multivariable ordinal logistic regression were fitted. The proportional odds ratio (POR) with a 95% CI and P value < 0.05 were considered statistically significant.

Results. The overall prevalence of stunting, underweight, and thinness was 29.5%, 35.7%, and 29.5%, respectively. In this study, 14.7% of the study participants had low academic achievement in the semester. The multivariable analysis showed that rural residence (POR = 0.39; 95% CI: (0.21, 0.75)), not studying regularly (POR = 0.49; 95% CI: (0.29, 0.82)), severe underweight (POR = 0.25; 95% CI: (0.09, 0.71)), and severe stunting (POR = 0.03; 95% CI: (0.01, 0.37)) were associated with decreased odds of high average semester score achievement of school-aged children. Additionally, higher maternal educational status (POR = 2.12; 95% CI: (1.10, 4.07)) and family income from 550 to 2999 ETB (POR = 1.71; 95% CI: (1.04, 2.81)) were associated with increased odds of high semester average score achievement. Conclusion. Nearly one-third of school-aged children in Lalibela town were stunted, thin, and underweight. Rural place of residence, not studying regularly, underweight, and stunting were associated with decreased academic achievement. While, family monthly income from 550 to 2999 ETB and higher maternal education status were associated with increased academic achievement.

1. Background

Globally, the magnitude and severity of malnutrition are still a public health problem. Malnourishment accounts for 2.6 million deaths per year and more than 450 million children’s failure in somatic and mental development [1]. Child undernutrition is a challenge of global health, especially in low- and middle-income countries [2]. Current evidences on children in Africa, Asia, and Latin America reported that the mortality of stunted and underweight children was greater than three times that of well-nourished children [3]. Anthropometric indices are commonly used to assess nutritional status, health, and development of children as well as the whole population [4, 5]. Nutritional status depends on dietary intake of food, nutrients, diseases and overall health status, and health care practices, which indirectly affects the educational performances [6]. Academic performance, intellectual development, and school attendance of the children...
and adolescents were adversely affected by undernutrition. On the other hand, good nutrition was associated with progress of perceptive and behavioral talents and improved school attendance [7, 8].

Empirical evidences witnessed the influence of nutritional status on academic achievement of the students. For example, in Indonesia, the cognitive development of preschool children was significantly affected by stunting, underweight, and severe wasting [9]. Additionally, low level of educational performance (marks < 40%) in Tamil (a language in Nuwara Eliya Educational Zone), mathematics, and overall subject average was significantly associated with underweight [10]. On the other hand, stunting is associated with decreased school-age enrolment and reduced achievement equivalent to three years of schooling as well as productivity deficit of greater than 20% [8, 11].

Though there are different issues raised for poor educational performances, 16% of the total repetition rate in primary education is highly associated with stunting in Ethiopia [12]. The participation rate of primary education is less than 22% of the relevant age cohort [13]. Similarly, realities in the country indicates that low educational performance rate of children with stunting is 15.1% and 11.2% with non-stunted children [14]. So, undernutrition was pointed to be associated with low educational achievements in primary education [15]. Higher risk of grade repetition and dropout of schools among age category of 6-18 years is still because of stunting [12].

Although there are several reports of malnutrition in Ethiopia, the relationship of nutritional status and educational performance of school-aged children was not yet explored in different areas of the country. Thus, this study was aimed at assessing nutritional status and academic achievements of primary school children in Lalibela, Northern Ethiopia.

2. Methods

2.1. Study Setting and Design. A school-based cross-sectional study was carried out from February 5 to March 30, 2017 in Lalibela town. Lalibela town is located in North Wollo Administrative Zone, which is 701 km from Addis Ababa, the capital of Ethiopia. According to the town health bureau population profile, the total population of the town is estimated to be 32,668. One district hospital and a health center provide health service in the town. With regard to education, one College, one preparatory school, one high school, nine primary schools, and two kindergarten schools are available in the town. There are about 2,992 total children in primary schools in the town [16].

2.2. Study Population. All school-aged children in Lalibela primary schools and those who lived in the town for at least six months were recruited in the study. The sample size was computed using Epi Info version 7, by considering the following assumptions: proportion of low academic performance in unexposed 34.9% [10], power = 80%, two -sided CI = 95%, ratio (unexposed : exposed) = 1, and OR = 1.667. By adding 10% nonresponse rate, the final sample size was 542. Four public schools were selected randomly from nine primary schools in Lalibela town. The sample size was distributed proportionally to the selected schools. Then, simple random sampling method was employed to select each study participant.

2.3. Data Collection Procedures. Structured, pretested, and interviewer-administered questionnaires were used for data collection. First, the questionnaire was prepared in English and translated into the local language, Amharic, and then translated back to English to check the consistency. Mothers or caregivers were interviewed on socioeconomic and other demographic data. Anthropometric data (height and weight) were collected from the school-aged children using standardized procedures. Weight was measured to the nearest 0.1 kg with an electronic scale. Child height was measured to the nearest 0.1 cm using a wooden stadiometer placed on a flat surface. Regarding educational performance, 2017-year first semester scores on Amharic (local language), English, Mathematics, and Science courses as well as semester average score were extracted from the roster book of students in each school. Three supervisors and five clinical nurse data collectors were recruited for data collection. Intensive training was given for the data collectors and supervisors by the primary investigator.

2.4. Study Variables. Academic performance was defined as low score if less than 50%, medium score if 50%-75%, and high score if ≥75% [15]. Undernutrition was assessed according to the new WHO recommendation using stunting (height-for-age score (HAZ − score < −2SD), underweight is a weight for age (WAZ − score ≤ −2SD), and thinness (body mass index for age (BAZ) < −2SD. The four categories were defined as normal (+1 to -1SD Z-score), mild (between -1 and -2SD Z-score), moderate (between -2 and -3SD Z-score), and severe (less than -3SD Z-score) [17].

2.5. Data Processing and Analysis. Data were coded and entered in SPSS version 22 and exported to Stata version 14 statistical software for analysis. HAZ, WAZ, and BAZ were calculated using AnthroPlus software version 1.0.4 by the WHO 2007 growth reference standard. Descriptive statistics were used to present the findings. A bivariable analysis was done for each subject and total average score separately. Variables with P values of < 0.2 in the bivariable analysis were entered into a multivariable ordinal logistic regression analysis to identify the independent predictors associated with academic achievement. In the multivariable ordinal regression, the statistical significance of a variable was declared with a P value of < 0.05. The proportional odds assumption was checked using the Pearson chi-squared goodness-of-fit test, and data were consistent with the fitted model.

2.6. Ethical Consideration. The procedure of this study was approved by the Institutional Review Board of Mekelle University College of Health Sciences. Formal letters of cooperation were written to all selected public primary schools in Lalibela Town Administration. Written consent was obtained from each parent, caregivers, and directly from the school directors of all study participants. Parents and
caregivers were kindly asked by formal letter to get permission before any procedure. Then, each study participant was asked for their willingness to participate in the study. Furthermore, we gave all the participants a full right to discontinue the procedures when they assumed that things were going bad with them.

3. Results

3.1. Sociodemographic Characteristics. A total of 505 school-aged children were included in the study which gives the response rate of 93%. The mean age of the participant was 9.45 ± 1.97 year. About 89.7% and 78.6% of the participants were living with their mothers and live in urban setting, respectively. Majority of them (98.6%) were Orthodox Christian. With regard to maternal characteristics, 79.3% and 46.9% of the mothers were married and illiterate on educational status, see Table 1.

3.2. Nutritional Status. The prevalence of stunting, underweight, and thinness was 29.5%, 35.7%, and 29.5%, respectively. Of all study participants, 89.3% ate breakfast and/or lunch before they went to school. Additionally, 55% of the study participant’s household did not use iodized salt.

19.6% of the families reported that they had offered special food like fish oil for their child during childhood period.

3.3. School Environmental and Academic Performance. In majority, 95.4% and 88.1% of the children like their school and have a smooth relationship with teachers and school administration. Among all study participants, 74.3% study their lesson on a regular basis and 87.7% did their homework and exercise. With regard to academic achievement, among all study participants, 17.6% in Amharic, 19.2% in English, 15.8% in Science, and 26.1% in the Mathematics course had low academic achievement. Additionally, 14.7% of them had scored below 50% on the semester average, see Table 2.

3.4. Factors Associated with Academic Performance of School-Aged Children. In this study, five ordinal regression models were fitted; one for overall semester average and four for each course. In the multivariable analysis, place of residence, maternal educational status, family income, studying regularly, underweight, and stunting were associated with semester average achievement of school-aged children. For a child who lived in the rural, the odds of high average semester score achievement was decreased by 61% compared to those who lived in urban settings given that all of the other variables in the model are held constant (POR = 0.39; 95% CI: (0.21, 0.75)). Children who have mothers with secondary and above educational status had more than two times higher average semester score than children with illiterate mothers (POR = 2.12; 95% CI: (1.01, 4.07)). Children who have mothers with secondary and above educational status had more than two times higher average semester score than children with illiterate mothers (POR = 2.12; 95% CI: (1.01, 4.07)). Additionally, a child whose family’s income was from 550 to 2999 ETB had 1.71 times higher odds of achieving high average semester score (POR = 1.71; 95% CI: (1.04, 2.81)) compared to that whose income was less than 550 ETB. Compared to children who study regularly, the odds of achieving high average semester

| Variables                  | Frequencies | Percent (%) |
|----------------------------|-------------|-------------|
| Gender                     |             |             |
| Male                       | 252         | 49.90       |
| Female                     | 253         | 50.10       |
| Is a child living with his mother? |             |             |
| Yes                        | 453         | 89.70       |
| No                         | 52          | 10.30       |
| Maternal age (year)        |             |             |
| <20                        | 3           | 0.59        |
| 20-25                      | 44          | 8.71        |
| 26-29                      | 90          | 17.82       |
| 30-35                      | 140         | 27.72       |
| >35                        | 228         | 45.15       |
| Residence                  |             |             |
| Urban                      | 397         | 78.61       |
| Rural                      | 108         | 21.39       |
| Maternal marital status:   |             |             |
| Married                    | 410         | 81.19       |
| Divorced                   | 50          | 9.90        |
| Separated                  | 33          | 6.53        |
| Widowed                    | 12          | 2.38        |
| Maternal religion          |             |             |
| Orthodox                   | 498         | 98.61       |
| Muslim                     | 7           | 1.39        |
| Family income per month (ETB) |         |             |
| <1000                      | 251         | 49.70       |
| 1001-2500                  | 189         | 37.43       |
| 2501 and above             | 65          | 12.87       |
| Number of family living together |       |             |
| 2                          | 46          | 9.1         |
| 3-5                        | 307         | 60.8        |
| >5                         | 152         | 30.1        |

Table 1: Sociodemographic and economic characteristics of the study participants in Lalibela primary schools (N = 505), 2017.

| Variables                  | Frequency | Percent (%) |
|----------------------------|-----------|-------------|
| Amharic score              | <50       | 89          | 17.6 |
|                           | 50-75     | 215         | 42.6 |
|                           | >75       | 201         | 39.8 |
| English score              | <50       | 97          | 19.2 |
|                           | 50-75     | 246         | 48.7 |
|                           | >75       | 162         | 32.1 |
| Science score              | <50       | 80          | 15.8 |
|                           | 50-75     | 205         | 40.6 |
|                           | >75       | 166         | 32.9 |
| Mathematics score          | <50       | 132         | 26.1 |
|                           | 50-75     | 207         | 41.0 |
|                           | >75       | 166         | 32.9 |
| Semester average score     | <50       | 74          | 14.7 |
|                           | 50-75     | 257         | 50.9 |
|                           | >75       | 174         | 34.5 |

Table 2: Descriptive results of academic performance of primary school children in Lalibela (N = 505), 2017.
score was decreased by 51% (POR = 0.49; 95% CI: (0.29, 0.82) among students who will not do so. Concerning nutritional status, severely underweighted children have 75% decreased achievement on average semester score compared to normal weighted children (POR = 0.25; 95% CI: (0.09, 0.71)). Similarly, severely stunted children have 97% decreased average semester score compared to normal children (POR = 0.03; 95% CI: (0.01, 0.37)), see Table 3.

In the second ordinal regression model, the Science course score was modeled. Accordingly, the results reveal that achieving higher Science course score was decreased by 52% among children who lived in rural areas as compared

| Variables          | Category | Semester average score achievements | Crude POR (95% CI) | Adjusted POR (95% CI) |
|--------------------|----------|--------------------------------------|--------------------|-----------------------|
| Maternal marital status | Married  | Poor 55  | 209 146 | 1 1 | 
|                     | Divorced | 14 23   | 13 0.5 | (0.28, 0.90)* 0.65 (0.30, 1.4) | 
|                     | Separated| 4 16    | 13 1.16 | (0.59, 2.29) 1.6 (0.64, 4.21) | 
|                     | Widowed  | 1 9     | 2 0.66 | (0.23,1.84) 0.96 (0.28, 3.3) | 
| Residence           | Urban    | 59 183  | 155 0.54 | (0.36, 0.81)* 0.39 (0.21,0.75)* | 
|                     | Rural    | 15 74   | 19 0.54 | (0.36, 0.81)* 0.39 (0.21,0.75)* | 
| Maternal education status | Illiterate | 38 137 | 62 1.26 | (0.85, 1.88) 1.20 (0.71, 2.03) | 
|                     | Primary  | 26 71   | 52 1.26 | (0.85, 1.88) 1.20 (0.71, 2.03) | 
|                     | Secondary and above | 10 48 | 60 2.63 (1.71, 4.05)* 2.12 (1.10, 4.07)* | 
| Maternal occupation | Housewife | 47 177 | 106 1.37 | (0.85, 2.20) 0.90 (0.46, 1.76) | 
|                     | Employed | 14 32   | 36 1.37 | (0.85, 2.20) 0.90 (0.46, 1.76) | 
|                     | Private business | 4 22 | 21 1.69 | (0.94, 3.03) 0.87 (0.40, 1.86) | 
|                     | Other    | 9 26    | 11 0.68 | (0.38, 1.23) 0.56 (0.24, 1.34) | 
| Number of family living together | <2 | 15 19 | 12 1 | 1 | 
|                     | 3-5      | 38 156  | 113 2.45 | (1.31, 4.56)* 1.43 (0.62, 3.29) | 
|                     | >5       | 21 82   | 49 2.05 | (1.07, 3.96)* 1.62 (0.65, 4.05) | 
| HH income           | <550     | 48 137  | 66 1.75 | (1.21, 2.52)* 1.71 (1.04, 2.81)* | 
|                     | 550-2999 | 22 95   | 72 1.75 | (1.21, 2.52)* 1.71 (1.04, 2.81)* | 
|                     | >3000    | 4 25    | 36 3.5  | (2.04, 6.03)* 1.32 (0.61, 2.85) | 
| HH iodized salt use | Yes      | 33 97   | 98 0.61 | (0.43, 0.85) 0.87 (0.54, 1.41) | 
|                     | No       | 41 160  | 76 0.61 | (0.43, 0.85) 0.87 (0.54, 1.41) | 
| Special foods took during childhood | Yes | 9 39 | 51 1 | 1 | 
|                     | No       | 65 218  | 123 0.43 | (0.28, 0.66) 0.74 (0.41, 1.33) | 
| Regular study       | Yes      | 48 191  | 136 0.67 | (0.46,0.99) 0.49(0.29,0.82)* | 
|                     | No       | 26 66   | 38 0.67 | (0.46,0.99) 0.49(0.29,0.82)* | 
| Under weight        | Normal   | 3 64    | 35 1 | 1 | 
|                     | Mild     | 8 59    | 54 1.29 | (0.78,2.11) 0.90(0.46,1.77) | 
|                     | Moderate | 27 39   | 24 0.39 | (0.22,0.68) 0.25(0.09,0.71)* | 
|                     | Severe   | 11 12   | 11 0.43 | (0.19,0.95) 0.61(0.15,2.47) | 
| Stunting            | Normal   | 11 108  | 56 1 | 1 | 
|                     | Mild     | 17 96   | 69 1.12 | (0.76,1.65) 1.48 (0.84, 2.61) | 
|                     | Moderate | 32 46   | 41 0.64 | (0.40,1.01) 0.89 (0.37, 2.15) | 
|                     | Severe   | 14 7    | 8 0.24 | (0.11,0.56) 0.03 (0.01, 0.37) | 
| Thinness            | Normal   | 14 115  | 72 1 | 1 | 
|                     | Mild     | 24 75   | 56 0.83 | (0.56,1.24) 1.22 (0.64, 2.32) | 
|                     | Moderate | 23 45   | 36 0.67 | (0.42,1.06) 1.49 (0.62, 3.60) | 
|                     | Severe   | 13 22   | 10 0.38 | (0.20,0.71) 0.64 (0.20, 2.02) |
to urban dwellers (POR = 0.48; 95% CI: (0.26, 0.90). Additionally, a child whose family’s income was from 550 to 2999 ETB had 1.67 times higher odds of achieving a high Science course score (POR = 1.67; 95% CI: (1.02, 2.75)) compared to that whose income was less than 550 ETB. With regard to nutritional status, moderate underweighted children had 68% decreased odds of achieving high science score compared to normal underweighted children (POR = 0.32; 95% CI: (0.12, 0.89)). Similarly, severely stunted children had 90% decreased odds of achieving a high Science score compared to stunted children as compared to normal children (POR = 0.10; 95% CI: (0.02, 0.61)), see Table 4.

With regard to Mathematics course score, a child whose family’s income was from 550 to 2999 ETB had 1.73 times higher odds of achieving a high Mathematics course score (POR = 1.73; 95% CI: (1.06, 2.81)) compared to that whose income was less than 550 ETB. Additionally, a child who did not study his/her lesson regularly had 41% decreased odds of achieving higher Mathematics course compared to their counterparts (POR = 0.59; 95% CI: (0.36, 0.97)). With regard to nutritional status moderate underweighted (POR = 0.34; 95% CI: (0.12, 0.92)) and severely stunted (POR = 0.05; 95% CI: (0.004, 0.48)) children had 64% and 95% decreased odds of scoring a high Mathematics score as compared to normal children, respectively, see Table 5.

In the multivariable analysis, ordinal logistic regression maternal education status, family size, residence, and underweight were statistically significant predictors of English and Amharic course scores. Moderate underweighted children had 66% decreased odds of achieving high English (POR = 0.34; 95% CI: (0.13, 0.91)) and Amharic (POR = 0.34; 95% CI: (0.13, 0.92)) courses score as compared to normal weighted children. Similarly, a child whose mother had secondary and above educational status has 2.02 and 2.78 times higher odds of achieving high English (POR = 2.54; 95% CI: (1.09, 3.77)) and Amharic (POR = 2.78; 95% CI: (1.47, 5.26)) course scores as compared to a child with an illiterate mother, respectively. A child who lives with more than five family members had 2.54 times higher odds of achieving higher English course score as compared to those who lived with less than two family members. On the other hand, a child who lived in rural areas had 65% decreased odds of achieving a high Amharic course score than those who lived in urban areas.

4. Discussion

This study is aimed at assessing the effect of nutritional status on academic performance of school-aged children. Accordingly, the prevalence of stunting, underweight, and thinness was 29.5%, 35.7%, and 29.5%, respectively. These study findings are lower than the findings in Sri Lanka in which 50%, 32%, and 34% of school-aged children are underweight, stunted, and thin, respectively [10]. The possible reason was the study done in Sri Lanka was done at the rural setting. The prevalence of stunting is similar with the study done in the urban settings of Fogera and Libo Kemkem districts, This need to be corrected as: However, it is different from the finding in the rural setting of Fogera and Libo Kemkem districts in which 42.7% of school-age children were stunted. The prevalence of thinness is higher than a study done at Fogera and Libo Kemkem districts, Ethiopia [18]. This difference could be due to the sociodemographic and geographic differences. The magnitude of stunting in this study is greater than the study done in a rural area of Morocco which was 22.8% [19].

Study finding revealed that a child who lives in rural area had 65%, 52%, and 61% decreased odds of high achievement in the Amharic course, Science course and average semester scores, respectively. This study finding was supported by a study done in Iran, which shows that cognitive function of children was associated with the place of residence [20]. Children who have mothers with secondary and above educational status have more than two times higher English, Amharic, and average semester scores given that all of the other variables in the model are held constant. This study finding is similar with a study done in Morocco, Malaysia, Iran, and Hawa Gelan, Southwest Ethiopia [15, 19–21]. This signifies the importance of educating females in improving the child nutritional status as well as academic achievement.

On the other hand, a child from a family with an income from 550 to 2999 ETB has 1.71, 1.67, and 1.73 times higher average semester, Science course, and Mathematics course score than that from a lower income family. The increase in household income may be linked to household food security and enhanced school attendance. This study finding was similar with a study done in Iran and Hawa Gelan, Southwest Ethiopia, where higher monthly house hold income was associated with student’s academic performance [15, 20]. This may be due to family income directly influencing the nutritional status of household members. With regard to academic performance, compared to a child who study their lesson regularly, those who did not study regularly have 51% and 41% decreased odds of achieving high average semester and Mathematics course score.

With regard to nutritional status, severely underweighted children have 75% decreased odds of achieving high average semester score compared to normal weighted children. Furthermore, moderate underweighted children have 68%, 64%, 66%, and 66% decreased odds of achieving high Science, Mathematics, Amharic, and English course scores compared to normal weighted children, respectively. This study finding was similar with a study done in Nuwara Eliya Educational Zone and Hawa Gelan, Southeast Ethiopia [10, 15]. But the finding is different from a study done in Morocco that indicates WAZ did not have a significant association with academic achievement of primary school children [19]. This can be more supported by the report of Christian Perspectives in Education, while adequate and high-quality nutrition improves good academic performance, yet malnourishment contributes to low educational achievement where its prevalence is higher in developing countries [22]. This may be due to improved nutritional status being associated with better ability to learn, fewer absences, improved behavior, and causing fewer disruptions in the classroom which increases academic performance [23].

Alternatively, severely stunted children have 97%, 90%, and 95% decreased odds of achieving high average semester score, Science course score, and Mathematics course score.
Table 4: Factors associated with Science course achievement among school-aged children in Lalibela town, North Ethiopia.

| Variables                      | Category       | Science course achievements | Crude POR (95% CI) | Adjusted POR (95% CI) |
|--------------------------------|----------------|-----------------------------|--------------------|-----------------------|
|                                |                | Poor | Medium | High   |                      |                     |
| Maternal marital status        | Married        | 57   | 184    | 169    | 1                     | 1                   |
|                                | Divorced       | 16   | 16     | 18     | 0.55 (0.31, 0.99)     | 0.85 (0.39, 1.87)   |
|                                | Separated      | 4    | 14     | 15     | 1.18 (0.60, 2.31)     | 1.77 (0.70, 4.52)   |
|                                | Widowed        | 3    | 6      | 3      | 0.49 (0.17, 1.43)     | 0.67 (0.19, 2.35)   |
| Residence                      | Urban          | 62   | 155    | 180    | 1                     | 1                   |
|                                | Rural          | 18   | 65     | 25     | 0.52 (0.35, 0.77)     | 0.48 (0.26, 0.90)*  |
| Maternal education status      | Illiterate     | 41   | 114    | 82     | 1                     | 1                   |
|                                | Primary        | 26   | 63     | 60     | 1.18 (0.80, 1.73)     | 1.23 (0.73, 2.08)   |
|                                | Secondary and above | 13 | 43    | 62    | 1.98 (1.29, 3.03)     | 1.34 (0.71, 2.54)   |
| Maternal occupation            | Housewife      | 48   | 158    | 124    | 1                     | 1                   |
|                                | Employed       | 15   | 26     | 41     | 1.36 (0.85, 2.18)     | 1.09 (0.55, 2.15)   |
|                                | Private business | 7  | 16    | 24     | 1.51 (0.83, 2.73)     | 0.91 (0.42, 1.97)   |
|                                | Other          | 10   | 20     | 16     | 0.79 (0.44, 1.41)     | 0.69 (0.29, 1.65)   |
| Number of family living together | < 2         | 12   | 20     | 14     | 1                     | 1                   |
|                                | 3-5            | 46   | 131    | 130    | 1.83 (1.01, 3.29)     | 1.04 (0.47, 2.30)   |
|                                | >5             | 22   | 69     | 61     | 1.73 (0.92, 3.30)     | 1.74 (0.73, 4.15)   |
| HH income                      | <550           | 47   | 124    | 80     | 1                     | 1                   |
|                                | 550-2999       | 27   | 76     | 86     | 1.65 (1.15, 2.37)*    | 1.67 (1.02, 2.75)*  |
|                                | >3000          | 6    | 20     | 39     | 2.98 (1.73, 5.13)*    | 1.29 (0.59, 2.83)   |
| HH iodized salt use            | Yes            | 36   | 81     | 111    | 1                     | 1                   |
|                                | No             | 44   | 139    | 94     | 0.64 (0.46, 0.89)     | 0.71 (0.44, 1.14)   |
| Does the child take special foods? | Yes         | 11   | 34     | 54     | 1                     | 1                   |
|                                | No             | 69   | 186    | 151    | 0.51 (0.33, 0.79)     | 0.92 (0.51, 1.66)   |
| Sick with diarrhea             | Yes            | 22   | 60     | 42     | 1                     | 1                   |
|                                | No             | 58   | 160    | 163    | 1.37 (0.94, 2.00)     | 1.40 (0.84, 2.33)   |
| Regular study                  | Yes            | 54   | 164    | 157    | 1                     | 1                   |
|                                | No             | 58   | 160    | 163    | 1.37 (0.94, 2.00)     | 1.40 (0.84, 2.33)   |
| Does the child like the school environment? | Yes         | 74   | 207    | 201    | 1                     | 1                   |
|                                | No             | 6    | 12     | 4      | 0.40 (0.18, 0.88)     | 0.46 (0.17, 1.21)   |
| Under weight                   | Normal         | 6    | 55     | 41     | 1                     | 1                   |
|                                | Mild           | 8    | 52     | 61     | 1.37 (0.83, 2.25)     | 0.85 (0.44, 1.66)   |
|                                | Moderate       | 24   | 35     | 31     | 0.51 (0.30, 0.89)     | 0.32 (0.12, 0.89)*  |
|                                | Severe         | 9    | 16     | 9      | 0.41 (0.19, 0.86)     | 0.59 (0.15, 2.33)   |
| Stunting                       | Normal         | 15   | 89     | 71     | 1                     | 1                   |
|                                | Mild           | 15   | 81     | 86     | 1.23 (0.84, 1.82)     | 1.68 (0.95, 2.98)   |
|                                | Moderate       | 36   | 44     | 39     | 0.48 (0.30, 0.75)     | 0.64 (0.27, 1.53)   |
|                                | Severe         | 14   | 6      | 9      | 0.25 (0.11, 0.57)     | 0.10 (0.02, 0.61)*  |
| Thinness                       | Normal         | 21   | 101    | 79     | 1                     | 1                   |
|                                | Mild           | 25   | 58     | 72     | 1.11 (0.75, 1.65)     | 1.75 (0.92, 3.31)   |
|                                | Moderate       | 23   | 37     | 44     | 0.85 (0.54, 1.34)     | 1.95 (0.83, 4.58)   |
|                                | Severe         | 11   | 24     | 10     | 0.46 (0.25, 0.83)     | 0.60 (0.38, 1.89)   |
Table 5: Factors associated with Mathematics course achievement among school-aged children in Lalibela town, North Ethiopia.

| Variables                  | Category             | Mathematics course achievements | Crude POR (95% CI) | Adjusted POR (95% CI) |
|----------------------------|----------------------|----------------------------------|--------------------|-----------------------|
| Maternal marital status    | Married              | Poor 103 168 139 Medium 1 1 High | 1                  | 1                     |
|                            | Divorced             | Poor 17 19 14 Medium 0.70 (0.40, 1.21) High 0.91 (0.43, 1.93) |
|                            | Separated            | Poor 7 14 12 Medium 1.16 (0.60, 2.23) High 1.28 (0.52, 3.12) |
|                            | Widowed              | Poor 5 6 1 Medium 0.38 (0.13, 1.07) High 0.41 (0.12, 1.43) |
| Maternal education status  | Illiterate           | Poor 68 103 66 Medium 1 High | 1                  | 1                     |
|                            | Primary              | Poor 45 58 46 Medium 1.04 (0.71, 1.52) High 0.80 (0.48, 1.34) |
|                            | Secondary and above  | Poor 19 45 54 Medium 2.12 (1.10, 3.2) High 1.85 (0.98, 3.49) |
| Maternal occupation       | Housewife            | Poor 85 146 99 Medium 1 High | 1                  | 1                     |
|                            | Employed             | Poor 25 22 35 Medium 1.26 (0.79, 2.00) High 0.88 (0.45, 1.72) |
|                            | Private business     | Poor 7 21 19 Medium 1.65 (0.94, 2.88) High 0.88 (0.42, 1.85) |
|                            | Other                | Poor 15 18 13 Medium 0.81 (0.46, 1.44) High 0.77 (0.33, 1.79) |
| Number of family living together | <2                 | Poor 18 18 10 Medium 1 High | 1                  | 1                     |
|                            | 3-5                  | Poor 73 124 110 Medium 2.05 (1.15, 3.67) High 1.60 (0.72, 3.53) |
|                            | >5                   | Poor 41 65 46 Medium 1.66 (0.90, 3.06) High 1.94 (0.81, 4.64) |
| Residence                  | Urban                | Poor 104 145 148 Medium 1 High | 1                  | 1                     |
|                            | Rural                | Poor 28 62 18 Medium 0.62 (0.42, 0.91) High 0.59 (0.32, 1.07) |
| HH income                  | <550                 | Poor 75 114 62 Medium 1 High | 1                  | 1                     |
|                            | 550-2999             | Poor 48 68 73 Medium 1.58 (1.11, 2.25) High 1.73 (1.06, 2.81) |
|                            | >3000                | Poor 9 25 31 Medium 2.60 (1.56, 4.36) High 1.39 (0.65, 2.95) |
| HH iodized salt use        | Yes                  | Poor 54 82 92 Medium 1 High | 1                  | 1                     |
|                            | No                   | Poor 78 125 74 Medium 0.64 (0.46, 0.88) High 0.96 (0.60, 1.53) |
| Deworming                 | Yes                  | Poor 99 166 135 Medium 1 High | 1                  | 1                     |
|                            | No                   | Poor 33 41 31 Medium 0.77 (0.52, 1.15) High 0.61 (0.38, 1.04) |
| Does the child eat breakfast/lunch before school? | Yes | Poor 113 187 151 Medium 1 High | 1                  | 1                     |
|                            | No                   | Poor 19 20 15 Medium 0.68 (0.40, 1.15) High 1.29 (0.60, 2.77) |
| Does the child take special foods? | Yes | Poor 16 38 45 Medium 1 High | 1                  | 1                     |
|                            | No                   | Poor 116 169 121 Medium 0.50 (0.33, 0.76) High 0.85 (0.48, 1.49) |
| Regular study              | Yes                  | Poor 86 156 133 Medium 1 High | 1                  | 1                     |
|                            | No                   | Poor 46 51 33 Medium 0.58 (0.40, 0.84) High 0.59 (0.36, 0.97) |
| Does the child like the school environment? | Yes | Poor 121 201 160 Medium 1 High | 1                  | 1                     |
|                            | No                   | Poor 10 6 6 Medium 0.51 (0.22, 1.16) High 0.99 (0.36, 2.73) |
| Under weight               | Normal               | Poor 9 60 33 Medium 1 High | 1                  | 1                     |
|                            | Mild                 | Poor 16 54 51 Medium 1.20 (0.74, 1.93) High 0.93 (0.49, 1.77) |
|                            | Moderate             | Poor 40 21 29 Medium 0.41 (0.24, 0.71) High 0.34 (0.12, 0.92)* |
|                            | Severe               | Poor 15 9 10 Medium 0.39 (0.18, 0.83) High 0.66 (0.17, 2.58) |
| Stunting                   | Normal               | Poor 21 102 52 Medium 1 High | 1                  | 1                     |
|                            | Mild                 | Poor 39 73 70 Medium 1.03 (0.71, 1.51) High 1.58 (0.91, 2.75) |
|                            | Moderate             | Poor 55 26 38 Medium 0.45 (0.29, 0.70) High 0.63 (0.27, 1.49) |
|                            | Severe               | Poor 17 6 6 Medium 0.23 (0.10 ,0.51) High 0.05 (0.004, 0.48)* |
| Thinness                   | Normal               | Poor 34 102 65 Medium 1 High | 1                  | 1                     |
|                            | Mild                 | Poor 44 55 56 Medium 0.86 (0.58, 1.26) High 1.33 (0.71, 2.47) |
|                            | Moderate             | Poor 36 34 34 Medium 0.67 (0.43, 1.05) High 1.36 (0.58, 3.18) |
|                            | Severe               | Poor 18 16 11 Medium 0.48 (0.26, 0.87) High 0.99 (0.33, 3.04) |
as compared to not stunted children. This study finding is similar with a study done in Sri Lanka in which low educational performance in Tamil (Language of Sri Lanka), Mathematics, and overall subject average was significantly higher among stunted participants than normal children [10]. However, it was different from a study done in Morocco, in which stunting was positively correlated with annual score and average score of Mathematics course score [9] and Malaysia where students educational achievement was not affected by stunting [21]. This may be due to nutritional status being able to directly affect mental capacity among school-aged children [23].

This study has its own limitations. First, the students’ academic performance was evaluated by semester scores and it may also vary due to pedagogical factors which were not considered in this study. Second, due to WHO AnthroPlus 2007 GS limitations, participants whose age is greater than 10 years especially females during underweight assessment were excluded due to the fact that their weight increases in spite of nutritional status but by hormonal factors during pubertal period, and as a result, the sample size became small for only underweight assessment.

5. Conclusion

Greater magnitude of malnutrition (stunting, underweight, and thinness) is found among primary school children in Lalibela town. This nutritional status significantly affects the educational performances of primary school children. Place of residence, family monthly income, maternal education status, and regular lesson studying, underweight, and stunting are statistically significant predictors of educational performance in Science, Amharic, English, Mathematics, and semester average scores. So, health and education sectors as well as other concerned bodies should work together to avert this adverse effect of malnutrition.

Data Availability

We confirmed that all data underlying the findings would be fully available without restriction if the manuscript is published.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Authors’ Contributions

MA, AB, and AB conceived and designed the study. MA and SH performed the study. MA, AB, AB, and SH analyzed the data. MA, AB, AB, and SH contributed reagents/materials/analysis tools. SH, MA, AB, and AB wrote the manuscript. All authors read and approved the final manuscript.

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References

[1] J. Padhy, “Hunger-undernourishment: where do we stand and where do we go?,” Research & Reviews: Journal of Medical and Health Sciences, vol. 4, no. 2, 2015.
[2] P. Svefors, A. Rahman, E.-C. Ekström et al., “Stunted at 10 years. Linear growth trajectories and stunting from birth to pre-adolescence in a rural Bangladeshi cohort,” PLoS One, vol. 11, no. 3, article e0149700, 2016.
[3] A. J. Prendergast and J. H. Humphrey, “The stunting syndrome in developing countries,” Paediatrics and International Child Health, vol. 34, no. 4, pp. 250–265, 2014.
[4] A. Srivastava, S. E. Mahmood, P. M. Srivastava, V. Shrotriya, and B. Kumar, “Nutritional status of school-age children - a scenario of urban slums in India,” in Archives of Public Health, vol. 70, no. 1, 2012BioMed Central, 2012.
[5] V. Gaiki and V. Wagh, “Nutritional status of adolescent girls from selected rural areas of a district from Central India,” Innovative Journal of Medicine and Health Science, vol. 4, no. 2, pp. 90–92, 2014.
[6] WHO Food and Nutrition Surveillance Systems, “Technical Guide for the Development of a Food and Nutrition Surveillance System,” vol. 33, WHO Regional Publications, Eastern Mediterranean Series, 2013.
[7] T. Belachew, C. Hadley, D. Lindstrom, A. Gebremariam, C. Lachat, and P. Kosteren, “Food insecurity, school absenteeism and educational attainment of adolescents in Jimma Zone Southwest Ethiopia: a longitudinal study,” Nutrition Journal, vol. 10, no. 1, 2011.
[8] UNICEF, “Multi-sectoral Approaches to Nutrition: the Case for Investment by Education Programmes,” https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjZ07jsoOrnAhVoQEEAHWXCp0QFJAAegQIBBAB&url=https%3A%2F%2Fwww.unicef.org%2FBrief_Education_Nutrition.pdf&usg=AOvVaw3M7trKO1z8xY7THJHuKqCud.
[9] O. Warsito, A. Khomsan, N. Hernawati, and F. Anwar, “Relationship between nutritional status, psychosocial stimulation, and cognitive development in preschool children in Indonesia,” Nutrition Research and Practice, vol. 6, no. 5, pp. 451–457, 2012.
[10] M. S. G. Sarma, D. G. N. G. Wijesinghe, and T. Sivananthaweli, “The Effects of Nutritional Status on Educational Performance of Primary School Children in the Plantation Sector in Nuwara Eliya Educational Zone,” Tropical Agricultural Research, vol. 24, no. 3, pp. 203–214, 2015.
[11] UNICEF, Approach to Nutrition Programming in the East Asia and Pacific Region 2014 - 2025, United Nations Children’s Fund, 2014.
[12] The Cost of Hunger in Africa, “Implications for the Growth and Transformation of Ethiopia. Social and Economic Impacts of Child Undernutrition in Ethiopia,” http://documents.wfp.org/stellent/groups/public/documents/newspaper/wfp263405.pdf.
[13] ETHIOPIA FDRGO, “Education and Training Policy,” 1994, EEP-86.
[14] Project CWaTH, “Investing in Nutrition to Achieve Sustainable Development,” 2016.
[15] F. Abebe, A. Geleto, L. Sena, and C. Hailu, “Predictors of academic performance with due focus on undernutrition among students attending primary schools of Hawa Gelan district, Southwest Ethiopia: a school based cross sectional study,” BMC Nutrition, vol. 3, no. 1, article 138, 2017.
[16] “Lalibela town Administration population profile,” September 2017.

[17] World Health Organization, UNICEF, WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children: Joint Statement by the World Health Organization and the United Nations Children’s Fund, 2009.

[18] Z. Herrador, L. Sordo, E. Gadisa et al., “Cross-sectional study of malnutrition and associated factors among school aged children in rural and urban settings of Fogera and Libo Kemkem districts Ethiopia,” PloS one, vol. 9, no. 9, article e105880, 2014.

[19] M. E. Hioui, F.-Z. Azzaoui, A. O. T. Ahami, and Y. Aboussaleh, “Nutritional status and school achievements in a rural area of Anti-Atlas, Morocco,” Food and Nutrition Sciences, vol. 2, no. 8, pp. 878–883, 2011.

[20] A. A. Tabriz, M. R. Sohrabi, S. Parsay et al., “Relation of intelligence quotient and body mass index in preschool children: a community-based cross-sectional study,” Nutrition & Diabetes, vol. 5, no. 8, article e176, Article ID BFnutd201527, 2015.

[21] H. M. Al-Mekhlafi, M. A. Mahdy, A. A. Sallam et al., “Nutritional and socio-economic determinants of cognitive function and educational achievement of aboriginal schoolchildren in rural Malaysia,” British Journal of Nutrition, vol. 106, no. 7, pp. 1100–1106, 2011.

[22] A. Woodhouse, P. D. Lamport, and A. Mark, “The relationship of food and academic performance: a preliminary examination of the factors of nutritional neuroscience, malnutrition, and diet adequacy,” Christian Perspectives in Education, vol. 5, no. 1, 2012, http://digitalcommons.liberty.edu/cpe/vol5/iss1/1.

[23] D. Just, “Three ways nutrition influences student learning potential and school performance,” EXTENSION (June 26, 2014), January 2017, https://articles.extension.org/pages/68774/3-ways-nutrition-influences-student-learning-potential-and-school-performance.