Correlation of overweight and academic achievement at grade 1-3 pupil at school of highscope Indonesia 2018

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Muhammad Hidayat Sahid

Clinical Epidemiology Faculty of Public Health, Universitas Indonesia

Corresponding address: Muhammad H. Sahid
Email: m.hidayatsahid@gmail.com

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Abstract

Background: Based on WHO data in 2011, 1 in 10 children in the world are obese (WHO, 2011). Nutritional status data in children aged 5-12 years in DKI Jakarta shows 14.0% underweight and overweight 6.8%. Data specifically for the South Jakarta region is 7.4% underweight and 7.3% overweight. Nutritional problems are one of the important factors that influence student academic achievement. The purpose of the study: to determine the effect of nutritional status on academic achievement of students in grades 1-3 in elementary school.

Methods: the design used was a retrospective cohort by looking at the relationship between the School Wide Assessment (SWA) score and the nutritional status of children in the previous 9 months. The population in this study were students in grades 1-3 at HighScope Indonesia School with a total sampling of 480 children.

Results: The results of this study indicate that there is a significant relationship between variables of nutritional status on academic achievement 6:29 RR (95% CI 3.82-10.35). In the cox regression analysis showed good nutritional status had RR at 3.17 (95% CI 2.404 to 4.204) and was significant at p-value 0.000. While other variables indicate that there is no significant relationship with the risk of having poor academic performance. In the final model cox regression analysis on variable nutritional status on achievement also showed RR values of 3.09 (95% CI 2.365 to 4.053) p-value 0.000.

Conclusion: Children who are overweight are at risk for having bad academic achievement of 6.3 times. (Health Science Journal of Indonesia 2019;10(1):32-40)

Keywords: Nutritional status, academic achievement, risk factors, retrospective cohort
Nutritional status for children measuring by body mass index that calculate with weight and height of children.\textsuperscript{1,2} The definition of obesity according to the World Health Organization (WHO) is the abnormal accumulation of body fat that will increased healthy risks,\textsuperscript{1,2} in 2007 reported that there were 95.2 million children, or approximately 14.3\% having prevalence of underweight in children’s nutritional status in the world,\textsuperscript{1} While based on data from the WHO in 2011 stated that 1 in 10 children in the world are overweight. Research of Bier (2007) also showed that more than 9 million children aged 6 years and over are overweight\textsuperscript{12}. In fact, since 1970, obesity problems in children tends to increase. These numbers tend to be doubled at children aged 2-5 year in 2007, and threefold in children aged 16-11 years.\textsuperscript{11,12}

The nutritional status in Indonesia, according to Riskesdas data 2013 on children aged 5-12 years, the prevalence of underweight is 11.2\%, consisting of 4\% of severe and malnutrition status 7.2\%\textsuperscript{4}, and also showed that obesity problems in children in Indonesia were quite high, with prevalence of 18.8\% comprising 10.8\% obese and very obese (obesity) as much as 8.8\%. Likewise for stunting prevalence is as much as 30.7\%, which is composed of 12.3\% malnutrition and 18.4\% severe nutrition status.\textsuperscript{4}

The nutritional status of school children aged 5-12 years in Jakarta shows 3.2\% is a very thin, 6.1\%, underweight, 4.0\% stunting and 10.0\% wasting\textsuperscript{4}. While in DKI Jakarta the nutrition data showed that 14.0\% underweight, 22.7\% stunting, 9.9\% wasting and 6.8\%. In South Jakarta showed 7.4\% underweight, 17.8\% stunting, 6.3\% wasting and 7.3\% overweight. These data showed of the nutritional problems that occurred in Jakarta.\textsuperscript{4}

The nutritional status of children will be having impacts on improving the quality of human resources. Chronic malnutrition or stunting is closely linked to getting lower in academic achievement school.\textsuperscript{5,6} Nutritional problems also have an impact on child development. Nutrition is one of important factor in contributing to the quality of education achievements\textsuperscript{7}. However, the nutritional problems actually just not only malnutrition but children who are overweight actually also having nutritional problems.\textsuperscript{11,13} The prevalence of stunting, underweight and wasting were 27.5\% (95\% CI 23.2–31.9\%), 20.4\% (95\% CI 16.5–24.3\%) and 8.7\% (95\% CI 6.2–11.5\%), correspondingly. Previous studies conducted in different areas have shown that under nutrition is common among school-age children; it was reported in the form of stunting range from 11 to 48.7\% and underweight from 7.2 to 59.7\%.\textsuperscript{12} A study conducted in eastern Ethiopia reported that the prevalence of stunting was 8.9\%, of which, 2\% had severe stunted among school-aged children.\textsuperscript{12} Though evidence about the prevalence of malnutrition is well studied in Ethiopia, there is insufficient evidence regarding nutritional status allied with academic performance among school-age children.\textsuperscript{12}

The low level of educational performance was significantly higher (p<0.05) among the stunted, underweight and wasted children than that of the normal children. In multivariable logistic regression, age of the child (Adjusted Odds Ratio (AOR)=0.177, 95\% CI0.07, 0.4), monthly income less <1000.00 birr (AOR=0.05, 95\% CI 0.02, 0.15), stunted children (AOR=0.21, 95\% CI 0.10, 0.43) and under-weight (AOR=0.63, 95\% CI 0.26, 0.84) were associated with academic performance. This study revealed that indicators of undernutrition were prevalent among school-age children. Thus, collaboration between the health and education sectors is required to alleviate the problem.\textsuperscript{11,12}

The purpose of this study is to determine the relationship of nutritional status with the cumulative academic achievement in grades 1-3 elementary school students in the HighScope Indonesia in 2018.

**METHODS**

This is a quantitative research with a retrospective cohort study aimed to look at the relationship between nutritional status and academic achievement. The data consist of dependent and independent variables. Taken from secondary data obtained from the recapitulation of the evaluation of student learning examination called School Wide Assessment (SWA) on the 3rd quarter of 2017/2018 school year its mean at March 2018. While the nutritional status data obtained from the health monitoring conducted by the school clinic at 9 months earlier, at June 2017.

This is how these restropective study conducting:
Based on academic achievement of HighScope Indonesia students in 2016 where the number of students who have a bellows level is 33.3% with RR is 1.5, the results of the calculation are as follows:

\[ P_1 = (RR) P_2 = 1.5 \times (0.333) = 0.499 \]
\[ p = (p_1 + p_2)/2 = (0.585 + 0.39)/2 = 0.416 \]
\[ d^* = p_1 - p_2 = 0.585 - 0.39 = 0.166 \]

Kelsey Sample Calculation Formula

\[ N = \frac{7.849 \times 0.416 \times 0.584 \times 2}{(0.166)^2 \times 1} \]

\[ = 3,813 \]
\[ = 0.027 \]

= 141.24 “rounded up to 142, this is the number of 1 group. So that if 2 groups become = 142 x 2 = 284. To anticipate a lost to follow-up or incomplete data, 20% is added to become = 341 samples.

The data was analyzed for statistical correlation and conducted with SPSS 24 serial to determine the relationship between the dependent and independent variables and also used logistic regression to determine the greatest affect between the variabels. Undernutrition in young children is often determined through measurement of height, weight, skin-fold thickness and age. The commonly derived indices from these measurements are: stunting - low height for age (HAZ), wasting - low weight for height (WAZ), underweight - low weight for age (WAZ) and BMI-for-age z-score.

Stunting is an indicator of chronic undernutrition, the result of prolonged food deprivation and/or disease or illness; wasting is an indicator of acute undernutrition, the result of more recent food deprivation or illness; underweight is used as a composite indicator to reflect both acute and chronic undernutrition although it cannot distinguish between them.

These indices are compared against an international reference population developed from anthropometric indices.
data collected in the United States by the National Center for Health Statistics (NCHS). Children whose measurements fall below –2 z-scores of the reference population median are considered undernourished, i.e. to have stunting, wasting or to be under-weight. Those children with measurements below –3 z-scores are considered to be severely undernourished.

Ethical Declaration

This study has been approved by Universitas Indonesia Public Health Ethics Committee with 420/UN2.F10/PPM.00.02/2018 as ethical number registered.

RESULTS

Respondents characteristics

Table 1. The Distribution Respondents Characteristics

| Respondent’s characteristics | n   | %  |
|------------------------------|-----|----|
| **Age**                      |     |    |
| 7 years                      | 163 | 34.9 |
| 8 years                      | 165 | 34.4 |
| 9 years                      | 152 | 31.7 |
| Total                        | 480 | 100 |
| **Number of siblings**       |     |    |
| ≤ 2                          | 336 | 70.0 |
| > 2                          | 114 | 30.0 |
| Total                        | 480 | 100 |
| **Order in family**          |     |    |
| elder                        | 254 | 52.9 |
| second                       | 215 | 44.8 |
| third                        | 8   | 1.7 |
| fourth                       | 3   | 0.6 |
| Total                        | 480 | 100 |
| **Gender**                   |     |    |
| Man                          | 240 | 50.0 |
| woman                        | 240 | 50.0 |
| Total                        | 480 | 100 |
| **birth weight**             |     |    |
| Low                          | 16  | 3.3 |
| Normal                       | 464 | 96.7 |
| Total                        | 480 | 100 |
| **Birth termination**        |     |    |
| preterm                      | 14  | 2.9 |
| aterm                        | 466 | 97.1 |
| Total                        | 480 | 100 |
| **Mother’s education**       |     |    |
| S1                           | 192 | 40.0 |
| S2                           | 224 | 46.7 |
| S3                           | 64  | 13.3 |
| Total                        | 480 | 100 |
| **Father’s education**       |     |    |
| S1                           | 64  | 13.3 |
| S2                           | 272 | 56.7 |
| S3                           | 144 | 30.0 |
| Total                        | 480 | 100 |

Respondents in this study were 480 students with aged 7 years are 163 children (34.9%), aged 8 years are 165 children (34.4%) and aged 9 years old are 152 children (31.7%). There were 16 (3.3%) subjects had a history of low birth weight and 14 (2.9%) of the children had a history of premature birth. The nutritional status of underweight are 12 (2.5%), and children who having overweight category are 112 (23.3%) and obese children are 131 (27.3%) children.

Nutritional Status of Respondents

Based on height, weight and age data of the respondents conducted by the school clinic in June 2017, the researcher calculating nutritional status using WHO Anthro-plus applications:

Calculating WAZ, HAZ and BAZ using data of the height, weight and age of the respondents. The result are:

Table 2. WAZ, HAZ and BAZ

| Variables | mean | Std. Error | Std. deviation | Min  | Max  |
|-----------|------|------------|----------------|------|------|
| WAZ       | 0.29 | 0.026      | .570           | -1.88| 2.39 |
| HAZ       | 0.30 | 0.019      | .463           | -0.76| 1.88 |
| BAZ       | 0.73 | 0.027      | 0.597          | -2.71| 2.66 |

After calculating the value of WAZ, HAZ and BAZ then the next step is referring to the Z-Score as shown in Table 1.2, so we will get the nutritional status of respondents into five categories as follows:

Then the nutritional status of respondents categorized into 3 categories: (1) Normal, (2) Underweight, (3) Overweight. The results were as follows:

Table 3. Nutritional Status 3 Category

| Variables | Category   | Frequency (n) | Percentage (%) |
|-----------|------------|---------------|----------------|
| Nutritional status | Normal | 354 | 47.3 |
|             | Underweight | 2 | 2.5 |
|             | Overweight  | 124 | 50.2 |
| Total       |             | 480 | 100 |

Counting and categorizing nutritional status is conducted in order to do bivariate and multivariate analysis to determine the influence of nutritional status on academic achievement.

Cumulative academic achievement based on school test’s scores using the School Wide Assessment (SWA) are 69.05 as the average value and the lowest score on the math and English are 56. While 95 is the highest score in English and Bahasa Indonesia.
Respondents Academic Achievement

Table 4. Cumulative Academic Achievement

| Variables                      | mean | Std.Error | Std. deviation | Min | Max |
|--------------------------------|------|-----------|----------------|-----|-----|
| English                        | 73.23| 0.49      | 1.07           | 56  | 95  |
| Indonesian                     | 73.27| 0.43      | 9.425          | 60  | 95  |
| Mathematics                    | 74.62| 0.433     | 9.50           | 56  | 91  |
| Science                        | 72.01| 0.39      | 8.54           | 60  | 90  |
| Cumulative Academic Achievement| 69.05| 0.41      | 8.98           | 56  | 95  |

Formulation to calculating into cumulative academic achievement is as follows:

Cumulative Academic Performance Score = (Bahasa Indonesia x 35%) + (English x 35%) + (Mathematics x 15%) + (Science x 15%). After that will be defined into 3 categories: (1) Proficiency if the score are 80-100, (2) Progressing if the score are 60-79 and (3) Bellow level if the score are under 30-59.

So based on the formulation of the results obtained cumulative value of academic achievement as follows:

Table 4. Cumulative Frequency Distribution of Academic Achievement

| Academic achievement                  | n   | (%)  |
|---------------------------------------|-----|------|
| Cumulative Academic Achievement       |     |      |
| Proficiency                           | 128 | 26.7 |
| Progressing                           | 141 | 29.4 |
| bellow level                          | 211 | 44.0 |

The frequency distribution of cumulative academic achievement in grade 1-3 are 128 students (26.7%) reach the proficiency level of, 141 students (29.4) is still progressing and 211 students (44.0%) is still on bellows levels.

Factors that Influence Nutritional Status

Nutritional status is the primary independent variable in this study, and would be analyze the effect of nutritional status on achievement is cumulative and will also be seen in greater depth effect on achievement in each subject. Due to the nutritional status of respondents divided into four categories: underweight, normal, overweight and obese then to the category bivariate analysis performed by dividing into two groups: good nutrition category and malnutrition. Good nutrition category contains respondents who have underweight and normal nutritional status. Category skinny inserted into good nutrition category because the respondents have a nutritional status at the level which is approaching the upper limit of normal category. While nutrition overweight and obese categories into malnutritional groups.

Next will be the analysis of the effect of nutritional status on cumulative academic achievement which is a cumulative value of the four subjects above. Here are the results:

Table 5. Relationship of Nutritional Status and Achievement Cumulative

| Variables           | Category    | Good Nutrition | Malnutrition | Total | RR  | 95% CI       | p-value |
|---------------------|-------------|----------------|--------------|-------|-----|--------------|---------|
| Nutritional status  | Good Nutrition | 253           | 71.0         | 103   | 29.0| 356          | 1       |
|                     | overweight   | 14            | 11.3         | 110   | 88.7| 124          | 6.29    |

On a cumulative academic achievement category, there were 253 children (71%) who are on good nutrition group, who has good academic achievement, and there were 103 children (29%) who had no good academic achievement. While the respondents have overweight there are 14 children (11.3%) who have a good academic achievement and 110 children (88.7%) who had no good academic achievement. Statistical analysis showed that the nutritional status of the respondents have a significant effect on student achievement with value RR of 6.29 (95% CI 3.82 to 10.35) and p value of 0.000. From the table we can see that children with better nutritional status have a greater risk up to 6.3 times to having poor academic performance.

Based on the analysis above it can be concluded that nutritional status has a significant effect on cumulative academic achievement even statistically proven to have a greater impact if compared with achievement in each subject.
**Multivariate analysis**

Multivariate analysis were performed to examine the relationship of dependent variables (nutrition status) and the independent variables together with covariate variables that can be estimated relationship between independent variables and the dependent variable after being controlled by other covariates. The results of the multivariate analysis between academics achievement and the nutritional status are mentioned in table 6. In Cox regression analysis showed good nutritional status has a RR at 3.17 (95% CI 2.404 to 4.204) and significant at p value = 0.000. Its mean that the students who have overweight having a risk for poor academic performance. While the other variables showed that no significant relationship to the risk of having poor academic performance.

The result of confounding variables test, found that there is no confounder of father’s education, mother’s education, gender, number of siblings, birth weight status, prematurity or pre-term birth, extracurricular and age. The final model of the analysis mentioned at table 7.

| Variable                              | RR      | 95% CI      | P-value |
|---------------------------------------|---------|-------------|---------|
| **Nutritional status**                |         |             |         |
| Good nutrition                        | (Ref)   |             |         |
| Overweight                            | 3.17    | 2.404 to 4.204 | 0.000  |
| **What order are you in the family?** |         |             |         |
| Child to 1 (Ref)                      |         |             |         |
| 2nd child                             | 1.10    | 0.327 to 3.736 | .871   |
| 3rd child                             | 1.13    | 0.328 to 3.904 | .844   |
| All 4 Kids                            | 1.35    | 0.291 to 6.273 | .700   |
| **Number of siblings**                |         |             |         |
| ≤ 2                                   | (Ref)   |             |         |
| > 2                                   | 1.08    | 0.779 to 1.517 | .624   |
| **Gender**                            |         |             |         |
| Man (Ref)                             |         |             |         |
| Woman                                 | 0.95    | 0.694 to 1.320 | .790   |
| **LBW**                               |         |             |         |
| Normal (Ref)                          |         |             |         |
| Low                                   | 0.93    | 0.556 to 1.569 | .797   |
| **Type of preterm birth**             |         |             |         |
| Normal (Ref)                          |         |             |         |
| premature                             | 0.90    | 0.170 to 4.869 | 0.911  |
| **Education level of mother**         |         |             |         |
| S1 (Ref)                              |         |             |         |
| S2                                    | 1.04    | 0.665 to 1.644 | .848   |
| S3                                    | 0.93    | 0.588 to 1.483 | .770   |
| **Education level of father**         |         |             |         |
| S1 (Ref)                              |         |             |         |
| S2                                    | 1.14    | 0.679 to 1.917 | .620   |
| S3                                    | 1.11    | 0.742 to 1.676 | .599   |
| **extracurricular**                   |         |             |         |
| Mixed (Ref)                           |         |             |         |
| Physical                              | 1.16    | 0.433 to 3.147 | .760   |
| Art                                   | 1.33    | 0.611 to 2.905 | .471   |
| **IQ**                                |         |             |         |
| Superior (Ref)                        |         |             |         |
| Normal Bright                         | 0.75    | 0.468 to 1.205 | .236   |
| Average                               | 1.01    | 0.666 to 1.537 | .955   |
Table 7. Results of Final Model Assessment of Nutritional Status Among the confounding Influence on Academic Achievement

| Variable       | RR  | 95% CI       | P-value |
|----------------|-----|--------------|---------|
| good nutrition |     | (Ref)        |         |
| overweight     | 3.09| 2.365 to 4.053 | 0.000 |

In the final model of the cox regression analysis on the nutritional status variables on achievement also demonstrates the value of RR of 3.09 (95% CI 2.365 to 4.053) p-value 0.000 so that it can be concluded that the nutritional status are variables that can have an influence on the risk of achievement poor academic in students.

DISCUSSION

The prevalence of nutritional status in this research are 2.5% underweight, and children who having overweight category are 23.3% and obese children are 27.3%. In contrast, this finding of overweight children was higher as compared to other previous studies conducted in Brazil was found (14.9% stunted and 9.7% wasted)\textsuperscript{12}, in Kenya (24% stunted, 14.9% underweight, 9.7% wasted)\textsuperscript{17}, in Nicaragua (5% wasted)\textsuperscript{18,19}. The reason for this observed discrepancy might be due to sociodemographic characteristics, area of sampling and study period.

Our analysis found a significant relationship between nutritional status and cumulative academic achievement. Children with overweight are at risk in not good cumulative academic achievement at 6.2 times when compared with children who are well-nourished. After multivariate analysis using cox regression to the variables studied are obtained variables that had a significant influence are nutrition status.

Previous study revealed that age and income were significant factors for academic performance among primary school children. This finding was consistent with a systematic review and meta-analysis showed that there is a strong association between academic performance and socio-economic status including age.\textsuperscript{20} Compromised socio-economic status of a family was statistically associated with poor academic performance in children.\textsuperscript{21} Similarly, other studies done in Southeast Ethiopia\textsuperscript{22} and in Malaysia\textsuperscript{23} reported that minimum wealth indexed score of the family were a positive association with poor academic performance. This might be due to a balanced nutritional intake for adequate biological functioning lead to the cognitive processes and the outcome of academic performance\textsuperscript{23,14}.

Research limitations

The limitations of this study are: (1) Potentially the lack of validity of secondary data is used both data about PSG and SWA. (2) Tend potential for the occurrence of selection bias and information bias due to the use of secondary data. (3) Limitations in the analysis of the other factors that influence academic achievement possible. (4) The result was a relative risk. (5) The sample used may be less representative of the population.

Data Quality

This study took a secondary data is data regarding school health monitoring are routinely conducted by the school clinic. The nutritional status periodically conducted by schools every two months, however, the research only used nutritional data on June 2017. Secondary data related to nutritional status is mainly about their weight and height measurements made by nurses served in the school clinic so that in this case the validity of the data on weight and height can be properly accounted for. However, researchers did not perform the calibration of the equipment and tools used to measure weight and height, so it is possible the potential for misclassification bias.

While the data on academic achievement is taken from the data tabulation of the value of the School Wide Assessment (SWA) where it is the form of the exam schools for students who are exclusively designed by Teacher & Research Department (TRD) to measure the achievement of teaching and learning activities as well as one component used by schools to evaluate the education system applied in Indonesia HighScope school. Validity of School Wide Assessment (SWA) which is compiled by the Teaching and Research Department (TRD) though drafted by a team that is also responsible for the development of educational curriculum in schools HighScope Indonesia but have never tested the validity and reliability test. One of the things that can lessen its validity by researchers is that form of matter from the School Wide Assessment (SWA) is based on a paper and pencil test, while the system of teaching and learning in schools HighScope Indonesia using active learning and also Project Based Learning (PBL). It is possible there is a student’s academic potential that may not be measured with a model question paper and pencil test. Nevertheless indeed
the School Wide Assessment (SWA) has been implemented by the School HighScope since 2014 with development efforts are continued until 2018. pencil test, while the system of teaching and learning in schools HighScope Indonesia using active learning and also Project Based Learning (PBL). It is possible there is a student’s academic potential that may not be measured with a model question paper and pencil test. Nevertheless indeed the School Wide Assessment (SWA) has been implemented by the School HighScope since 2014 with development efforts are continued until 2018. pencil test, while the system of teaching and learning in schools HighScope Indonesia using active learning and also Project Based Learning (PBL). It is possible there is a student’s academic potential that may not be measured with a model question paper and pencil test. Nevertheless indeed the School Wide Assessment (SWA) has been implemented by the School HighScope since 2014 with development efforts are continued until 2018.

The use of secondary data in this study is made of the limited data obtained by researchers because it is based only on data available to other factors which may affect the nutritional status can not be identified with more depth, while the primary data conducted by researchers only be complementary if No respondents have data that is incomplete, for example in terms of birth history data, birth weight and other data.

Respondents were used in this study was grade 1-3 elementary school, although the total sampling was taken and no respondents were lost to follow-up and yet there is still potential for selection bias because it can not represent the entire elementary school students from grades 1-6 where possible have different characteristics primarily related to age and nutritional status wherein the multivariate analysis both variables are variables that give large influence on achievement.

Validity Research

Exclusion and inclusion criteria set out in the sample selection is expected to minimize selection bias. The use of total sampling as a technique of sampling is also an effort to anticipate the existence of selection bias. However, the direct election of the site and the respondents used in this study could potentially lead to selection bias because it may not represent the general population of elementary school students in grade 1-3.

Outcome and risk factors in this study have also been the case in the past however, a lack of accuracy the validity of the measurement may still be occurs namely in terms of the measurement of nutritional status, the researchers do not know exactly the measurement process and the use of the measuring instrument, but due to the measurements performed by professional nurses, the potential for misclassification bias can be minimized. While in terms of the outcome measurement tools namely School Wide Assessment (SWA), made possible bias which has never done any test the validity of the test forms or types of questions used in the School Wide Assessment (SWA) is. Although determining the location and sample directly, but the number of samples used in this study have exceeded the minimum sample size, this study can be generalized to the general population. If the population have different types of schools with the School HighScope Indonesia.

In conclusion, the results of this research is nutritional status in the 1-3 grade elementary school students in the HighScope Indonesia Elementary School in 2018 divided into three categories: underweight, normal and overweight. There is a significant relationship between the variables of nutritional status on cumulative academic achievement. children with overweight were at risk in poor cumulative academic achievement compared to children who are well-nutritioned. Better nutritional status or children with overweight have a greater risk up to 6.3 times to having poor academic performance. Base on cox regression analysis, this study finded that the nutritional status are variables that can have an influence on the risk of achievement poor academic in students.

Educational activities to parents with effective communication which contains information about the importance of nutritional status of children, especially awareness of nutritional problems both nutrition and undernourishment. So that not only the child, thin and very thin are considered to have nutritional problems, but also on overweight should also get attention too. The parents also need to be aware of the influence of nutritional status and age to academic achievement so it would be more wise in choosing the food intake and type of school or training appropriate to the child’s age.

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