Correlation of nutritional status with academic achievement in adolescents

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Abstract. Malnutrition is considered a problem that limits learning ability (cognitive function), which is related to poor academic achievement results. This study aimed to determine the relationship of nutritional status with academic achievement in adolescents. A cross-sectional study was conducted on 126 junior high school students ranging from 12 to 15 years in Batubara, North Sumatra in January 2015. Nutritional status is determined by weight for height. Academic achievement was recorded from the final results of their school exams. The value of intelligence quotient (IQ) was assessed by using the Aptitude Test. Data were then analyzed by using Spearman correlation and Chi-Square test. In conclusion, there was no significant difference between nutritional status with IQ score (p=0.540) but showed a significant relationship (p=0.003) between normal nutritional status with the total value of the report card with positive weak correlation strength (r=0.342). There was also a significant difference (p=0.020) and moderate positive correlation (r=0.541) between overweight with academic achievement based on mathematics.

1. Introduction
According to the World Health Organization (WHO), the definition of adolescence is an individual with an age range of 10-19 years, progressing from the first time showing secondary sexual signs until reaching sexual maturity, which develops psychological and identification patterns from childhood to adult as well as a transition from full socioeconomic dependence to a relatively more independent state.¹ Adolescence is considered as a period of transition from childhood to adulthood, being an individual who is doing development tasks in the search for identity and learning process.²⁻³

Academic achievement in adolescents is influenced by factors that come from the internal and external self of the individual.⁴ The interaction of these factors as determinants of how the end result of the learning process experienced by the individual and the role of each factor is not always the same and fixed.⁵

Nutritional status is one of the internal factors that may affect academic achievement.⁶ Malnutrition is considered a problem that can limit the child's ability to learn, resulting in lower academic achievement compared with children with good nutrition.⁷

Intelligence (cognitive) is one of the internal factors that participate in determining academic achievement.⁸ Intelligence becomes the basis for talent development, but the talent is not the same as intelligence. Talent introduces a condition that indicates a person's potential to demonstrate
proficiency in a particular field. The tool used to unveil this ability is called the Aptitude test, and in this test, IQ can also be assessed.

The aim of this study is to investigate the correlation between nutritional status with academic achievement in adolescents.

2. Method
A cross-sectional study was conducted on 12 to 15-year-old junior high school students in Batubara, North Sumatera during January 2015. Total of 126 subjects was recruited to this study by consecutive sampling. Nutritional status was determined by weight-for-height. Nutritional status was assessed by plotting weight and height into the curve of weight for height WHO-CDC 2000 for boys and girls. The classification of nutritional status is obesity, overweight, normal weight, mild-moderate malnutrition, and severe malnutrition.

Academic achievement was recorded from their final results of school examination. Intelligence quotient (IQ) score was assessed by using Aptitude Test. Aptitude test is a test of talent for examining the basis of the potential ability of students and can assess IQ score, consisting of the special intelligent, highly intelligent, smart, above average, below average, weak, very weak and very weak once.

The inclusion criteria were all junior high school students of eight and ninth grade in SMPN-1 Talawi and TanjungTiram. We excluded children who reduced food intake and were consuming drug-lowering appetite, periodically purging food habit, behavioral disturbances, and was not undergoing weight and height measurement as well as the Aptitude test.

The collected data were processed, analyzed, and presented using an SPSSv19.0 application. Categorical data were assessed by percentage. Kolmogorov-Smirnov test is used to assess the normality of data distribution. Spearman correlation was used to analyze the data to determine the correlation of nutritional status with academic achievement (based on the total score of school report card) and correlation of nutritional status with academic achievement based on the school subjects of Indonesian language, English language, mathematics, and science. To see the correlation of nutritional status with IQ score using Aptitude test we used Chi-Square test. The confidence interval of this study was 95%, and significance P value was less than 0.05.

3. Results
Based on the characteristics of subjects, the age range of the subjects was between 12.5–15.8 years. We found mostly both paternal and maternal with the same education level of senior high school (37.3% and 36.5%), monthly household income less than IDR < 1 million (41.3%), normal weight (57.1%), and average IQ score (85.7%) (table 1).

| Characteristics               | N = 126          |
|-------------------------------|------------------|
| Age (years), median (range)   | 14.3 (12.5 – 15.8) |
| Sex, n (%)                    |                  |
| Male                          | 36 (28.6)        |
| Female                        | 90 (71.4)        |
| Paternal education level, n (%) |              |
| Diploma                       | 8 (6.3)          |
| Senior high school            | 47 (37.3)        |
| Junior high school            | 18 (14.3)        |
| Completed elementary school   | 30 (23.8)        |
| Not completed elementary school | 23 (18.3)     |
| Maternal education level, n (%) |           |
| Diploma                       | 3 (2.4)          |
| Senior high school            | 46 (36.5)        |
| Junior high school            | 28 (22.2)        |
Table 2. Correlation of nutritional status with academic achievement (based on the total score of school report card).

| Nutritional status | Total score on school report card |
|--------------------|----------------------------------|
|                    | r      | p    |
| Obesity            | -0.167 | 0.693|
| Overweight         | 0.023  | 0.927|
| Normoweight        | 0.342  | 0.003|
| Mild-moderate malnutrition | -0.025 | 0.899|

Table 2 shows the results of the analysis using Spearman correlation test, which obtained a significant relationship between normal nutritional status with the total value of the report card ($p<0.05$). Normal nutritional status has a Spearman correlation value of 0.342; this indicates that the direction of positive correlation with a weak correlation strength. While the nutritional status of obesity, overweight and mild-moderate malnutrition has an insignificant relationship to the total value of report cards ($p>0.05$).

Table 3. Correlation of nutritional status with academic achievement based on the school subjects of Indonesian language, English language, mathematics, and science.

| Nutritional Status | Indonesian Language | | | English Language | | | Mathematics | | | Science | |
|--------------------|---------------------|---|---|------------------|---|---|-----------------|---|---|-----------------|---|
|                    | r      | p    | r      | p    | r      | p    | r      | p    | r      | p    |
| Obesity            | -0.690 | 0.058| -0.344 | 0.405| -0.344 | 0.405| -0.214 | 0.610|
| Overweight         | 0.185  | 0.462| -0.136 | 0.590| 0.541  | 0.020| 0.440  | 0.068|
| Normoweight        | 0.071  | 0.553| 0.046  | 0.702| -0.263 | 0.026| 0.024  | 0.840|
| Mild-moderate malnutrition | -0.305 | 0.114| 0.122  | 0.538| -0.103 | 0.602| -0.236 | 0.227|

Table 3 shows a significant difference and moderate positive correlation between overweight with academic achievement based on mathematics ($p<0.05$, $r=0.541$). There were also a significant difference and weak negative correlation between normalweight with academic achievement based on mathematics ($p<0.05$, $r=-0.263$).
Table 4. Correlation of nutritional status with IQ scores using Aptitude test.

| Nutritional Status          | Intelligence Quotient Score |          | P     |
|-----------------------------|----------------------------|----------|-------|
|                             | Smart                      | Above average |      |
| Obesity                    | 1                          | 7        |       |
| Overweight                 | 3                          | 15       | 0.540 |
| Normoweight                | 11                         | 61       |       |
| Mild-moderate malnutrition | 3                          | 25       |       |

Table 4 shows no significant difference between nutritional status with IQ score (p > 0.05).

4. Discussions

In the study, the prevalence of mild-moderate malnutrition was 22.2%, the second most nutritional status after normal nutritional status (Table 1). Compared with the South East Asian Nutrition Survey (SEANUTS) study group\(^1\) in Indonesia, Malaysia, Thailand, and Vietnam, reported mild moderate-to-moderate malnutrition prevalence of 21.6% and 19.2% of stunted children. Where mild-moderate malnutrition is found in most of Indonesia, moderate malnutrition is 25.2%, and stunted children are 29%. Health problems faced by Southeast Asian countries, including Indonesia, are the low nutritional status of children. Malnutrition in children affects the immune system against illness and intelligence, which clearly affects the quality of human resources.

In this study obtained respondents research with female more than men, with median age 13.5 years (12-15). This study was conducted in the middle to lower population, with income per capita <1 million IDR, also with the most recent educational background of most parents are high school graduates. The low level of parental knowledge will result directly to the lack of stimulation the child receives to develop his academic achievement. Both backgrounds of socioeconomic status are closely related to nutritional status. The cognitive abilities and verbal ability of the sample are influenced by the length of maternal education, whereas the father's educational length has a significant relationship with the non-verbal ability of the research sample. It is expected that parents should have the highest education to support the development of children's cognitive abilities.\(^10\)\(^11\)

In this study, academic achievement in adolescents is assessed from the total value of report cards and the total score of report cards. The average academic value in the sample study is the total value of regular report cards and the value of each subject, mathematics, Indonesian, English and science are common. In this study, IQ scores were also scored, where IQ group distribution of nutritional status was found to be insignificant. In each group, the nutritional status was found for the intelligent IQ group and the mean IQ.

In this study, there was a significant weak positive correlation between overweight nutritional status and mathematics score but did not have a significant relationship with the total value of report cards. In this study, there was no significant relationship between obesity nutrition status with Indonesian, English, Mathematics and Science score in adolescents. Whereas in normal nutritional status had a significant negative correlation with significant mean and positive correlation with the total value of report cards (table 3).

Research Li et al. (1995)\(^12\), reported obese children have a lower IQ score than normal children, especially in the language aspect. The low IQ is a predictor that causes the child to become obese. In the Hartini\(^13\) study in Denpasar, there was found a significant association between the degree of obesity with mathematics achievement and Indonesian primary school students, and there was a stronger relationship between the degree of obesity with Indonesian achievement compared with mathematics. This is because obesity is associated with OSAS, where snoring at night results in daytime drowsiness, resulting in less concentration in school hours.\(^14\)

In this study, there was no significant relationship (p>0.05) between nutritional status and IQ score (table 4). Another study conducted in Malaysia\(^1\) found a significant relationship between nutritional status with academic achievement and cognitive function in children. Malnutrition in children will disrupt the information system in the brain. This is evidenced by a study in Wonogiri, Central Java,
which reported malnourished children had an average IQ score of 22.6 points lower than normal nutritional status. Even before the nutritional status of children is lacking, children with dietary deficits have an arithmetic score of 0.4 points lower and 1.4 times greater risk of staying in class. This shows there is a negative relationship between food inadequacy with school children’s academic grades and psychosocial development.15

5. Conclusion
This study showed a significant relationship between normal nutritional status with the total value of the report card (p<0.05), but positive correlation with a weak correlation strength (r=0.342). Also showed a significant difference and moderate positive correlation between overweight with academic achievement based on mathematics (p<0.05, r=0.541). There were also a significant difference and weak negative correlation between normalweight with academic achievement based on mathematics (p<0.05, r=-0.263). But in the end, this study showed no significant difference between nutritional status with IQ score (p>0.05).

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