

Nutritional Status and Cognitive Function in the Adolescent's Rapid Growth Phase between 12-14 Years Old

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Abstract: Adolescence is a period of transition from childhood to adulthood. One of the transitions is the cognitive aspect of thinking ability. Poor nutritional status can harm children's growth and development. The factors that influence cognitive development are the nutritional status that affects adolescent intellectual development. The relationship between the nutritional status and the cognitive function in the adolescent's rapid growth phase between 12-14 years old is not clear. This study aims to identify the relationship between the nutritional status and the cognitive function in the adolescent's rapid growth phase between 12-14 years old. This study used observational analytical design and a cross-sectional approach with an adolescent group population of 12-14 years old. The research subject was a total of 71 people. Primary data included weight and height while secondary data included MMSE-Child and questionnaires. The data were analyzed using the Chi-Square statistical test. Based on the measurement of Body Mass Index (BMI), most research subjects had a normal nutritional status with a total of 32 people (45.10%). Furthermore, 63 people (88.70%) have a normal cognitive function. There was no significant relationship between Nutritional Status and MMSE scores ($p=0.454$). Likewise there were no significant relationship between gender and MMSE scores ($p=0.750$), age and MMSE scores ($p=0.255$). In this study, there was no significant relationship between nutritional status and cognitive function.

Keywords: adolescent, cognitive, nutritional

1. INTRODUCTION

Adolescence is a transition to adulthood. Individual adolescence experiences various physical changes, emotion, and psychic. In the process of their growth, adolescence encounter several phases which lead them to have direct contact with their surrounding environment. WHO defined early adolescence occurs at the age of 10-14 years old, while late adolescence occurs at the age of 15-20 years old. The period of adolescence known as providing a unique process in human's life [1,2,3].

The cognitive transition relates to teenager's thinking ability. In this transition process, teenagers begin to have a better ability to think about the hypothesized situation [28]. The cognitive development in adolescence is a point where teenagers reach the stage of formal operational thinking practice in which they are already able to think about abstracts, hypotheses as well as possibility and probability. Furthermore, it is also the ability to think about all the systematic ways in problem-solving [4,5].

Cognitive function is conscious mental activities such as thinking, remembering, learning, and using language. Cognitive function also includes an ability of attention, memory, consideration, problem-solving, as well as executive ability such as planning, assessing, supervising, and evaluating. One of the factors affecting cognitive development is nutritional status. It is the factor that affects the Intellectual development of adolescents. Good nutrients are assets for human resources development. Lack of nutrients at a young age can affect mental development and thinking ability. The brain reaches its maximum form at two years old. Moreover, lack of nutrients can also result in the disruption of permanent brain functions [1,6].

Poor nutritional status can harm children's growth and development. Children with poor nutrition have smaller brains than the average brain size. Their brain cell is 15-20% smaller than those with enough nutrition. Nutritional deficiencies in adolescents also have an impact on the lags of mental growth and development, as well as increasing numbers of absence due to illness. The long-term nutritional problems experienced by children will give effect to brain development, intellectual Quotient (IQ), and Scholastic Achievement (SA) in their coming adulthood [6,7,8].

Abnormalities that occur due to malnutrition has an impact, one of which is decreased brain function that affects learning abilities [29]. The children who were malnourished at the beginning of their life, did not level up their school classes, and repeated in the first year at least one time and 17-20% repeated in the second year. Malnutrition in adolescents has an impact that children easily suffer from mental disorder, difficulty concentrating, low self-esteem, and decreased learning achievement. From this research it is proven that sufferers of malnutrition experience barriers to brain growth and intelligence levels [9,10,11,12]. The relationship between the nutritional status and the cognitive function in the adolescent's rapid growth phase between 12-14 years old is not clear.

2. OBJECTIVES

The purpose of the presented study was to assess the correlation between nutritional status and cognitive function in adolescent's rapid growth phase between 12-14 years old.

3. MATERIAL AND METHODS

This research used an observational analytic research design with a cross sectional study approach. The study was conducted at Junior High School Mlati 2 (SMP Negeri 2 Mlati), Yogyakarta, Indonesia.

The population in this research was a group of early adolescents aged 12-14 year old. The method of taking samples is by purposive sampling. Nutritional status is a person's physical condition measured by comparing height and weight as well as the body mass index and that it can be determined if the person's health condition is balanced. The weight and height were measured by using an anthropometry measurement presented in the form of Body Mass Index based on age (BMI/U). Cognitive function was conscious mental activities like thinking, remembering, learning and using language measured by using MMSE-C examination (Modified Mini-Mental State Examination Child). The Data included in this study were the identity of the student (full name, age, gender, medical history). The ranging score of MMSE-C varies based on age with cut off points such as 3-5 years old ≥ 24 ; 6-8 years old ≥ 28 ; 9-11 years old ≥ 30 ; 12-14 years old ≥ 35 . Cognitive function is considered being disturbed if the MMSE-C is less than cut off points.

4. RESULTS

Table 1. Distribution of subject characteristics

Category	Frequency (n = 71)	Percentage (%)
Gender		
Male	30	42.30
Female	41	57.70
Total	71	100
Age		
12	14	19.70
13	53	74.60
14	4	5.60
Total	71	100
Nutritional Status		
Very thin (nutrition is not good)	16	22.50
thin (nutrition is not good)	12	16.90
Normal (Good nutrition)	32	45.10
Fat (nutrition is not good)	2	2.80
Obese (nutrition is not good)	9	12.70
Total	71	100
Category MMSE-C		
Normal (>35)	63	88.70
Disrupted (< 35)	8	11.30
Total	71	100
Parents' occupation		
Civil Servant	15	21.13
Self-employed	31	45.10
Other	24	33.80
Total	71	100
Physical Activity		
Normal	71	100
With limitations	0	00.00
Total	71	00.00
Environmental Factors		
Convenient	71	100
Less convenient	0	00.00
Total	71	100

Table 1 showed that the characteristics of the subjects collected include gender, age, nutritional status, and MMSE-Child category. The highest percentage of most respondents was female which was 57.70%. The largest percentage based on age was 13 years old which

was 74.60%, while the smallest percentage was 14 years old (5.60%). The ranging age of the research subject was included in early adolescence. This phase usually takes place along with puberty or physical transition from childhood to adulthood. The nutritional status of the most research subjects was in a good or normal category which was 45.10% while the least percentage of the nutritional status was not in good condition and was categorized as overweight (2.80%). The highest percentage of cognitive function was at the normal category which was ≥ 35 (88.70%).

Table 2 showed that the correlation between nutritional status and the cognitive function of children's rapid growth phase between 12-14 years old was not statistically significant ($p = 0.454$).

Table 2. Correlation between Nutritional Status and MMSE scores

Nutritional Status	MMSE				
	Normal		With Disruption		P
	N	(%)	N	(%)	
Good nutrition	27	42.90	5	62.50	0.454
Not good nutrition	36	57.10	3	37.50	
Total	63	100.00	8	100.0	

Table 3 showed that the biggest normal cognitive function was in female (60,30%) while the biggest percentage of cognitive function with disorder was in males (62.5%)

Table 3. Correlation between gender and MMSE

Gender	MMSE				p
	Normal		With Disruption		
	N	(%)	N	(%)	
Male	25	39.70	5	62.5	0.79
Female	38	60.30	3	37.5	
Total	63	100	8	100	

Table 4 showed that the highest percentage of the correlation between age and normal cognitive function was at 13 years old (73%). Meanwhile, the largest percentage of cognitive function with age interference was at 13 years old (87.50%).

Table 4. Correlation between age and MMSE

Age	MMSE				p
	Normal		With Disruption		
	(n)	(%)	(n)	(%)	
12	14	22.20	0	0.00	0.255
13	46	73.00	7	87.5	
14	3	4.80	1	12.5	
Total	63	100	8	100	

5. DISCUSSION

Based on the result of this research, it is shown that the respondent's age of male and female adolescents ranges from 12 to 14 years old. A group of 12-14 years old is where adolescents encounter puberty. Based on the research conducted at Junior High School 2 Mlati Sleman, it revealed that most students are categorized as students with normal nutritional status with a total of 32 students (45.10%), thin and less thin of 28 students (39.40%), overweight and obese category of 11 students (15.50%). In terms of cognitive function category of students at Junior High School 2 Mlati Sleman, it revealed that respondents with normal cognitive function were 63 students (88.70%) while those with disrupted cognitive function were 8 students (11.30%).

In this research, body mass index measurements were calculated using the formula $\text{height (m): weight (kg)}^2$. This measurement data refers to a good body mass index according to WHO if obtained figures of 18.5-25.0 [13]. In this research respondents who had a normal body mass index were 32 students. While the body mass index that is not good is divided into overweight and underweight. Weight loss can be divided into thin and very thin. Thin is obtained if the body mass index is 17.0-18.4 and very thin is obtained if the body mass index is <17.0 . The number of respondents in the thin category was 12 students (16.90%) while very thin was 16 students (22.50%). Being overweight can be divided into overweight and obese. The fat category is obtained if the body mass index is 25.1-27.0 and obese is obtained if the body mass index is > 27.0 . The total respondents in the obese category was 2 students (2.80%) while obese was 9 students (12.70%).

Mini mental status examination is a questionnaire that is used as an indicator to determine a person's cognitive function [28]. In this questionnaire an assessment of the orientation, registration, attention / calculation, memory, and language functions is carried out [30]. In the orientation function that is assessed is the child's ability to determine his ability to understand the orientation of time and place. At the registration assessment, the child is asked to repeat the three words that were done shortly after the examiner finished

delivering three short words. This was to determine the child's memory ability for a moment [31]. The attention/ calculation function is performed by repeating the sequence of numbers and repeating the sequence of numbers. This function can assess the child's ability to pay attention and calculate mathematically [14,15].

In addition to the above function, on the memory function, students asked to give back three words that have been submitted by the examiner. This assessment is used to see the ability of children in short-term memory. The next stage is language skills. Students are asked to show the five parts of the body, imitate sentences delivered by the examiner, carry out the examiner's orders, write, read, imitate images. Language assessment is used to see students' abilities about vocabulary, understanding commands, writing and reading [14,15].

After the five assessments are carried out, the MMSE value calculation is then performed with a maximum value of 37. MMSE values >35 fall into the normal category while MMSE values <35 fall into the category of disturbances. From the research students with normal MMSE scores were 63 students. Whereas children with MMSE scores who experienced disruption were 8 students with details of 5 students having normal nutritional status and 2 obese students, 1 student was very thin.

Based on the research data above, it shows that MMSE which is experiencing disruption occurs mostly in children who have a normal body mass index. In addition, the above results are also supported by several other similar studies that show the same results [32]. For example research conducted by Stefi (2014) which states that there is no meaningful relationship between nutritional status with learning achievement in students in SMA Negeri 1 Padang (p value = 0.882). The other research that supports this research is research conducted by Sherly (2013) who examined anthropometric factors that influence cognitive function by MMSE examination in student aged 10-12 years. From these results obtained showed that there was no significant relationship between anthropometrics and MMSE scores [16,17,18]. In addition to the research references above, there are studies that show conflicting results with this research, these research were found that the better the nutritional status, the better the learning achievement [19,20,21,22].

Other factors that affect nutritional status directly are food intake and infectious diseases that are influenced by economic factors, productive families and housing conditions. Effect of food on brain development if it does not contain enough nutrients needed and ongoing will cause metabolic changes in the brain resulting in the inability of the brain to function normally [23,24,25,26,27].

This research was conducted with a cross sectional method which means that the data

collection was done only once. If you want to see the effect of nutrients on the brain with a long time it is necessary to do research by cohort method.

6. CONCLUSION

Based on the result of the research, several conclusions were obtained, such as: the number of adolescents with a 'very thin' nutritional status category was 16 students, 'thin' category was 12 students, 'normal' category was 32 students, 'fat' category was 2 students, and 'obese' category was 9 students. The result of this study showed that there was no correlation between the nutritional status and cognitive function in children's rapid growth phase between 12-14 years old.

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