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Effect of Obesity on Cognitive Function:

A Comparative Study of Cognitive Level in Normal Weight and Obesity Students at Senior High School in West Java Indonesia

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***Abstract*—The purpose of this research was to determine the relationship of cognitive function between students in normal and obesity categories in high school. The method used in this research is descriptive quantitative research. The population in this study were high school students in Subang City. The technique in this study uses Saturation Sampling and Simple Random Sampling techniques. The samples that have been determined in this study are 44 students high school using descriptive research designs. The instruments used in this study are Growth Chart, grid concentration exercise, digit span, and TPA (Academic Potential Test). The results of the analysis, the value of Tcount for data with Equal Variances Assumed is 2.409 with value of probability (p-value) is 0.02. Based on the data from the analysis, the value of Tcount (2.049) with a probability value (0.020) is smaller (<) than 0.05. Then H0 is rejected, so it can be concluded that there are significant differences in cognitive functions between normal student and obesity categories.**

Keywords: cognitive function, obesity

I. INTRODUCTION

The prevalence of obesity in various countries continues to increase. In developed countries like the United States, obesity is estimated to reach 45-50%, the United Kingdom and Australia reach 30-40%. World Health Organization (WHO) predicts around 2.3 billion adults worldwide will gain weight or overweight and more than 700 million will be obese in 2015.

The prevalence of obesity in Indonesia is increasing. Basic health research data shows the central obesity rate in adolescents aged ≥ 15 from 2007 to 2018 nationally at 18.8% in 2007 which increased to 26.6% in 2013 and in 2018 it increased to 31.0%, while Data in West Java province in 2018 shows a slightly higher number than the national figure of 32%

Obesity is a pathological condition with accumulation of excess fat than is needed in body systems, if it occurs for a long time, and with insufficient activity to burn the excess energy, the fat will be converted and stored in fat cells under the skin. Obesity is an imbalance between energy intake and expenditure, where the intake is greater than the energy expended resulting in the accumulation of fat in adipose tissue. The total amount of adipose tissue is more than 25% body weight for men and more than 30% of body weight in women is another definition of obese. Obesity can occur at any age and has a very varied clinical picture ranging from mild to very severe [1-4].

Obesity can cause a variety of physical problems such as low back pain, osteoarthritis, increase the risk of chronic diseases including type 2 diabetes, high blood pressure, stroke, heart attack, heart failure, cancer (certain types of cancer, for example prostate cancer and colon cancer), gallstones, vesicolithiasis, gouty arthritis, sleep apnea, pickwiskian syndrome [5,6].

Besides physical problems, psychological problems also occur. Because of the physical problems above, obese children are often the target of bullying by their friends or the surrounding environment, this makes a negative self-image likely to appear, low self-esteem, feel different, unable to compete due to physical limitations, and other psychological problems. Obese children also tend to be nimble, easily tired, and sleepy. This will have a very negative impact on them [5,7,8].

Obesity can affect the level of intelligence of children. Pyle's research states that adolescents who are obese have lower learning achievement compared to teens who are of normal weight. Obese teenagers are also associated with being unable to do physical activities. Wearing statement obesity in early life can decreased performance in motor functions and physical exertion tests [9,10].

Cognition is a combination of various skills including: attention, learning, memory, speech and language, fine motor skills, visuospatial, and executive functions. Cognitive is the ability to think and provide rationally including the process of remembering, assessing, orienting, perceiving and maintaining it. Furthermore, cognitive is the ability of one's recognition and interpretation of the environment in the form of attention, language, memory, visuospatial, and deciding [11-13].

Cognitive functions are conscious mental activities such as thinking, remembering, learning and using language. The function of cognition is also the ability of attention, memory, judgment, problem solving, and executive abilities such as planning, evaluating, monitoring and evaluating. The function of cognition consists of five domains, namely: Attention, memory, visuospatial, language and executive functions.

Based on the previous study, obesity can cause symptoms degenerative diseases such as diabetes, cholesterol, hypertension, colon cancer, anxiety, depression, osteoporosis, and also the risk of cardiovascular disease can indirectly affect students' cognitive function. Authors interested in doing research to see if obesity can also affect cognitive function directly in adolescents.

II. METHOD

This study aim to examine the influence of obesity on the function of cognition in adolescents aged 15-18 years and compared it to adolescents with normal weight in the district of Subang, West Java Indonesia. This descriptive quantitative study used cross-sectional design. This study consists of cognitive function variable and group of students who are categorized as normal and obese.

Population in this study were students of Senior High School 3 Subang who were categorized as normal and obese. This study using non-probability sampling technique is saturated sampling for students who are categorized as obese. Samples of students categorized as normal using random sampling techniques. The sample for normal students is 24 people. A total of 44 students high school were measured in weight, height, nutritional status using CDC growth chart, concentration level using grid concentration exercise, memory ability using digit span, and academic potential test to measure visuospatial skills and executive function.

Anthropometric measurements are carried out by measuring weight (using Karada Scan), measuring height, then determining body mass index. Then the height and weight are carried out to the growth chart of the CDC. Weight growth chart are taken based on age (weight for age), height (stature) based on age (stature for age), and weight by height (weight for stature).

The instrument for measuring concentration uses the Grid Concentration Exercise module adopted from D.V. Harris and B.L. Harris [14]. Grid Concentration Exercise is a concentration measurement tool in the form of tables containing numbers 00 to 99 randomly. In conducting this test it is necessary to have 100 boxes containing numbers from 01 to 99 randomly. Before carrying out the test, the subject must have adequate rest and have breakfast. Testees rank numbers from the smallest to the largest value by connecting numbers with horizontal, vertical lines in one minute.

The author uses an instrument Test Digit Span to measuring the ability of memory, this test consists of two models, namely forward and backward digits adopted from Turner and Ridsdale [15].

Academic Potential Test is a test that aims to measure a person's ability in the general academic field. This test is also often identified with someone's intelligence test. Academic Potential Test generally has the type of questions that are verbal or language tests, numerical tests, logic tests, and spatial or picture tests. The academic potential test is part of a cognitive test that measures a person's maximum performance and is used to reveal potential abilities to predict academic ability. In this study the authors used the Academic Potential Test instrument adopted from the Academic Potential Test module created by Sihombing and Setiyawan [16].

The analysis process was carried out with the SPSS (Statistical package for social science) version 24. The normality test was carried out to determine the form of data distribution obtained as a prerequisite for further parametric testing. The Normality Test is performed using the Shapiro Wilk test. At p-value> α 0.05 the data is normally distributed and if p-value <α 0.05 then the data is not normally distributed. Homogeneity test to find out if the data comes from homogeneous or heterogeneous population variance. Homogeneity test used in this research is to use Levene's Test with ρ value $\geq$ 0.05. Hypothesis testing with the aim to find out whether there are sufficiently clear and reliable differences between the independent variables and the dependent variable, which will draw a conclusion of acceptance or rejection of the hypothesis that has been formulated. This procedure is used to compare the average of one variable in five data groups. Hypothesis testing is done using an independent sample t-test.

III. RESULTS

Build upon the normality test, it was found that the data group in the normal and obese categories had a normal distribution due to the results of the data calculation, the normal data group had a significance value (p-value) in the amount of 0.190 greater than (>) 0.05. While the obesity data group has a significance value (p-value) that is equal to 0.527 greater than (>) 0.05. It can be concluded that the data group that has normal and obesity categories has a normal overall data distribution.

Based on homogeneity testing, the results showed that the data group with normal and obese categories came from a homogeneous population because the results of data calculation all had an F value of 0.118 with a significance (p-value) of 0.733. Then the F value and the significance (p-value) of the two data groups have values greater than (>) 0.05. Then it can be concluded that all data come from the same variance (homogeneous).

Regarding the Independent T Test, the differences in the average function of students' cognition is 14.67, from the average cognitive function of students in the normal category minus the average cognitive function of the obese category students (156.67-142.00 = 14.67). Cognitive functions in the normal and obesity students have a different worth 10.33%.

The results showed t value is 2.409 with a probability value (p-value) of 0.020. P-value < 0.05. It can be concluded that there are significant differences in cognitive functions between normal weight student and obesity categories.

IV. DISCUSSION

Childhood obesity is related to low psychosocial well-being and high risk for life-threatening diseases in adulthood, an evidence obtained from a study shows the adverse effects of obesity can affect cognitive function and excess visceral adipose tissue (VAT) can exceed metabolic dysregulation and can affect cognitive function and brain health, with greater effects observed for tasks that require cognitive control.

Cognitive function in this case a combination of concentration which is the ability to maintain attention, memory, language, visuospatial, and executive functions is the focus of this study. It can be identified that the average cognitive function in obese students is lower than normal weight students. The results in this study support the results of previous studies that show the impact of obesity on cognitive abilities. Although some studies have shown the effect of obesity on cognitive function, other studies have shown cognitive function in healthy children and adolescents are not related to high body mass index [17].

Apart from differences in results in several studies, obesity in children and adolescent must still be prevented early. Many negative effects due to obesity require the role of all parties such as parents, teachers, health practitioners, the private sector, and the government to make policies related to the prevention and treatment of obesity.

The management of obesity should ideally be done as early as possible. At the first 6 months of life exclusive breastfeeding and postponement of complementary feeding until the age of 6 months, avoiding foods containing sugar, not giving juice in bottles, not introducing TV or other media, maintaining sleep 12-18 hours a day, and remain active as long as possible is an effort to prevent obesity in early age. In children and adolescents who have a smart phone can use it to record physical activity and food intake in day by day and compare it with their peers. After puberty, teens generally become less physically active, so adolescents who are obese should do physical activity and exercise regularly for 60-90 minutes with moderate to vigorous activity. The length and quality of sleep must be maintained, not to sleep late because of activities on social media or video games. Inadequate sleep will affect hunger mechanisms and it will contribute to obesity. Teenagers need to sleep at least 10 hours a day [18].

V. CONCLUSIONS

This study was designed to examine and compare cognition in obese and healthy school adolescent. Students who have a normal weight category tend to have higher cognitive function than obese students, the frequency of learning of students who are categorized as obese can be given special treatment to help deal with this condition. School children with obesity should reduce their weight in order to have cognitive functions within the normal range. Some efforts from the schools that students have many categories of obesity, teachers should provide treatment and education for these students to increase awareness of the problem of obesity. Schools can also play a role by increasing student's physical activity and managing school canteens to provide healthy snacks and not provide obesogenic food.

The findings of noteworthy differences in cognitive functions reinforce the need for additional research across the BMI spectrum and how different cognitive limitations confront successful weight management.

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