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Relationship between obesity and cognitive intelligence in junior high school students

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Abstract

Background Obesity is a global health problem. This condition may cause negative impacts on children's cognitive function. Early detection of obesity may lessen these impacts.

Objective To determine the relationship between obesity status and cognitive intelligence in children.

Methods A cross sectional study was conducted for two months (June to July 2008) on 7th grade students at three Junior High Schools in the Wenang subdistrict of Manado City, Indonesia. We included children aged 12-13 years, registered in 2007-2008, who gave parental consent, and who suffered from obstructive sleep apnea syndrome (OSAS) and hypertension. We excluded children who were sick at the time of the study, suffered from epilepsy, attention deficit hyperactivity disorder (ADHD), congenital heart disease, or malnutrition. Data were analyzed using Somers' D Test.

Results There were 52 boys out of 100 subjects studied**.** Fifty eight students (58%) had a normal BMI, and 42 were obese (36 with mild obesity, and 6 with moderate obesity). Out of the 42 obese students, 1% had a defective IQ, 1% had a below average IQ, 22% had an average IQ, 7% had an above average IQ and 11% had a superior IQ. From 58 subjects with a normal BMI, none had a below average IQ, 20% had an average IQ, 18% had an above average, and 20% had a superior IQ. The mean IQ scores for obese and non-obese subjects were 108.7 and 114.1 respectively.

Conclusion Obesity has relationship with cognitive intelligence in junior high school students. **[Paediatr Indones. 2009;49:165-8]**.

Keywords: *obesity, cognitive intelligence*

Obesity is the excessive accumulation of adipose tissue.[1] Industrialization and globalization have changed the dietary patterns and life styles of people around the world. Widely available fast foods make people pay less attention to balanced nutrient guidelines and their increased calorie intake results in obesity.[2]

It is already known that obesity may cause a negative impact on children's growth and development. These may range from simple to serious impacts, that can include impairment of cognitive functions such as cognitive intelligence and academic performance.[3-5] Some studies have indicated that nutritional deficiency (macronutrient or micronutrient) causes cognitive impairment in children.[6] Recently, investigators have started to determine the influence of nutrients on children's intelligence. Some studies have reported that obese children and adolescents have lower IQ scores and academic performances than those who were not obese.[7-10] The existence of brain impairment

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in obese children can adversely affect intelligence; therefore early detection of obesity is necessary. We aimed to find out the relationship between obesity and cognitive intelligence in junior high school students.

Methods

This cross sectional study was conducted in three junior high schools in the Wenang sub- district of Manado City from June to July 2008. Subjects were selected by stratified random sampling through two stages: unproportionally stratified for obese and non-obese by body mass index (BMI), and proportionally stratified by school. We included subjects aged 12-13 years who were registered during 2007 to 2008 school year, gave parental informed consent, those who suffered from OSAS, and those who had hypertension. We excluded children who were sick, those with history of epilepsy, attention deficit hyperactivity disorder, congenital heart disease, or malnutrition.

We used BMI to categorize obesity status. Obese subjects in this study were defined as having a BMI ≥ 25. Subjects were classified into mild obese when BMI ≥ 25-29.9, moderate obese when BMI = 30-40, and severe obese when BMI > 40. Non-obese status was assigned when BMI = 18-24.9. Cognitive intelligence testing was performed by a psychologist using standard progressive matrices (SPM), expressed as IQ score. The IQ scores were classified as follows: defective (IQ≤79), below average (IQ=80-89), average (IQ=90-109), above average (IQ=110-119), and superior (IQ>120).[11] Data were analyzed using Somers'd test. P value of <0.05 was used to identify statistical significance.

Results

During the two month period, 100 students were enrolled. The prevalence of obese students in this study was 42%, 36 subjects with mild obesity and six subjects with moderate obesity. The remaining 58 students (58%) had a normal BMI.

Next we examined the relationship between obesity status and IQ as determined from the cognitive testing. The complete distribution can be seen on **Table 1**. From 42 obese subjects there were variations in cognitive intelligence classification, where one subject had a defective IQ, one subject had a below average IQ, 22 subjects had an average IQ, seven subjects had an above average IQ, and 11 subjects had a superior IQ. From 58 non-obese subjects, there were no subjects with below average IQ, 20 subjects with an average IQ, 18 subjects with an above average IQ, and 20 subjects with a superior IQ. This data indicated that all the subjects with a below average IQ were obese, and those with an average IQ or greater than average IQ were more commonly non-obese subjects.

Table 3. Distribution of students according to obesity status and cognitive intelligence

IQ Classifications	BMI		Total
	Non obese	Obese	
Defective	0	1	1
Low average	0	1	1
Average	20	22	42
Above average	18	7	25
Superior	10	11	31
Total	58	42	100

There was significant statistical relationship between obesity and cognitive intelligence when the data was analyzed using the Somer'd test. The analysis revealed a weak correlation coefficient (r) of -0.219 (P=0.044). The mean IQ scores were 108.7 and 114.1 for obese and non-obese subjects respectively. An independent t-test was carried out and found that the mean IQ scores between obese and non obese students was statistically significant (P = 0.024).

Discussion

Distribution of IQ scores from a large population will appear as a bell-shaped curve indicating a normal distribution. The IQ scores with the highest frequency are located in the middle of the curve and are described as a normal IQ (IQ=90-109).[12] Our study results did not show this distribution for IQ scores, probably because of the relatively small subjects and the nearly homogenous population. In this study, most subjects commonly had an IQ score that was average

or above, regardless of obesity status. The students in this study were taken from favorite schools in Manado city who were assumed to be selected students.

In a study at a secondary school, Mo-suwan *et al* found that obese children had a lower IQ and poorer academic performance (mathematic and language) compared to non obese children.[8,9] Zhang *et al* in their study on 6-16 year old children in the US found that dietary fat intake was associated with cognitive function.[10]

Previous studies have reported that between 36 and 59% of obese children and adolescents suffer from OSAS, and between 20 and 30% have hypertension.[4,5,13] These risk factors, as well as the increase risk of heart disease that comes with obesity, can influence the cognitive function of brain through hypoxia. If hypoxia occurs in intermittent episodes, brain cells can be damaged and this can lead to atrophy.

Some studies have reported that high resolution magnetic resonance imaging (MRI) studies of the brain in OSAS patients have shown evidence of gray matter volume loss in the frontal and parietal cortex, temporal lobe, hippocampus, and cerebellum.[14] Obesity in children often occurs concurrently with OSAS and this condition can cause neurobehavioral morbidities such as learning and cognitive defects as well as behavioral problems associated with inattention and hyperactivity.[15]

Likewise, with hypertension associated increased left ventricular mass, several longitudinal studies have shown that there is an association between hypertension and increased left ventricular mass with impaired later-life cognition.[16] Hypertension may have effects on potential risk factors for brain and central nervous system degeneration, indicative of cognitive impairment.[5,16,17]

There were some limitations of this study as some factors that may influence the cognitive intelligence, such as genetic factors, socioeconomic status, level of education, and parental factors, were not considered.

The mean IQ score for obese subjects with an average IQ classification was 108.7 and for non-obese subjects it was 114.1 with P value = 0.024. Therefore, from this study we conclude that there is significant relationship between obesity and cognitive intelligence in 12-13 year old junior high school students. The higher degree of obesity, the more likely it is that cognitive intelligence will be lowered.

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