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Association Between Body Fat Masses with Vitamin D Serum in Adolescent with Obesity

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Abstract: ***Background: vitamin D is a fat soluble vitamin. The study found obese people had lower vitamin D levels and tended to have vitamin D deficiency. The purpose of this study was to determine the relationship between body fat mass and vitamin D levels in adolescents with obesity. Methods: This was an analytic cross sectional study with the subject of obese adolescents aged 12-15 years and was recruited consecutively at several schools in the city of Denpasar. Body fat mass is calculated using Parizkova method. The correlation between body fat mass and vitamin D was tested using linear regression. Results: Thirty-three subjects with the majority male sex were analyzed to have a mean body fat mass of 3.41%, with a mean vitamin D value of 18.41 ng/mL. A moderate negative relationship was found between body fat mass and vitamin D (r = -0.421 with P = 0.015). Conclusion: This study found that in adolescents with obesity there is a moderate negative relationship between the mass of body fat and vitamin D***

Keywords: adolescent obese, body fat mass, vitamin D

1. Introduction

Obesity causes serious public health problems around the world. Obesity is an independent risk factor for cardiovascular disease and significantly increases the risk of morbidity and mortality.1,2 In past two decades health care costs have increased due to obesity and related issues among children and adolescents. Childhood obesity is a global phenomenon that affects all socioeconomic groups, regardless of age, gender or ethnicity.3

Childhood obesity affects both the developed and developing countries of all socioeconomic groups, regardless of age, gender or ethnicity. The proportion of school-aged children affected was nearly doubled in 2010 compared to the most recent survey available from the late 1990s to 2003.4 Obesity has become a serious public health problem affecting large populations in countries such as the United States. Among children aged 6 to 19 in 1999-2002 31% were overweight and 16% were obese.5 The prevalence of obesity in Indonesia based on data from the Riskesdas Department of Health in 2010, chlidren age 6-12 was the group with highest prevalence of obesity by 9.2%. Obese children in the province of Bali alone were found to be 7.1%.6 Obesity is defined as an abnormal or excessive cumulation of fat that can affect a person's health. In children the criteria used todiagnoses the obesity is by using the Body Mass Index (IMT) compared with the growth curve by age and sex.7

In obesity also found micronutrient deficiencies such as vitamin D, cromium, biotin and thiamin. The malnutrition conditions of some of these nutrients are related to insulin resistance and type 2 diabetes mellitus in obesity.8 The association between vitamin D deficiency and comorbid found in obese individuals, where vitamin D deficiency affects inflammatory processes in obese children.9,10 Diabetes mellitus is also affected by vitamin D levels, studies proved the correlation of vitamin D and blood sugar balance.11 In obese individuals there is a decrease in vitamin D bioavailability due to build up in fatty tissue, so the level of vitamin D in the blood will be low and affect the metabolism and its function in the body.12 This study aims to determine the correlation between body fat mass with vitamin D levels in adolescents with obesity.

2. Method

This is an associate study with cross-sectional design, to find relationship between fat mass with vitamin D levels in obese adolescents age 12 to 15 years old. Data were collected from previous research data on the relationship between body fat thickness and vitamin D in adolescents with obesity.

Target population are adolescents aged 12 to 15 who are obese. Affordable populations are adolescents with obese in several public and private Junior High Schools in Denpasar. The sample was chosen consecutively until the sample size was met. Inclusion criteria are all children aged 12 to 15 years who are suffering from obesity.

Exclusion criteria were:
1) Subjects with major congenital abnormalities
2) Subjects with genetic disorders
3) Subjects with hormonal disorders
4) Subjects suffer from liver disease
5) Subject suffering from kidney disease
6) Subjects get one or more of the following drug therapies: corticosteroids, anticonvulsants, or antidepressants for more than 2 weeks

This study uses single linear regression with significance level of p <0,05 and power 80%. Calculation of the sample size by the formula:

N=f(α,β, VB, R2)
α : 5%
β : 20%
R2 : 0,20

Based on this calculation then got the number of subjects in this study at least as many as 33 adolescents who suffer from obesity. Assessment and explanation of the ethics of this

research is given by Research Ethics Committee of Medical Faculty of Udayana University and Sanglah Hospital Denpasar. Data from this study include: gender, age, body weight, height, body mass index, body fat mass, vitamin D levels. The operational definition of this study is as follows:

1) Age is the chronological age (date of birth) expressed in a year with rounding down if less than 6 months and rounding up when more or equal to 6 months. Age obtained from an interview or birth certificate, expressed on a numerical scale.
2) Sex is a phenotypic appearance distinguished as male and female, expressed on the nominal scale of the dichotomes.
3) Weight is expressed in kilograms (kg), obtained by weighing the subject by using an electric scales brand Secca®
4) Height is expressed in centimeters (cm), obtained by measuring the subject using a brand height meter Secca®
5) The Body Time Index is obtained by calculation using the formula

$$\frac{BB(kg)}{TB(m^2)}$$

BB = Berat badan

6) Adolescents who suffer from Obesity are teenagers who suffer from abnormalities in fat storage measured by calculating the Body Time Index and then inputted into BMI / BMI curves based on age and gender of CDC 2000. Obesity is obtained if the input value of BMI / IMT is more than or equal to (>) 95th percentile.
7) Vitamin D levels are levels of 25 (OH) D measured from blood samples, expressed on a numerical scale with units of nanogram / milliliter (ng / mL).
8) Kidney disease is a disease of the kidney organ that has been diagnosed by a doctor based on examination and laboratory results.
9) Liver disease is a disease in the liver that has been diagnosed by a doctor based on the results of the examination and laboratory support..
10) Long-term drug consumption is a history of drug consumption including corticosteroids, anticonvulsants, and antidepressants with a duration longer than 2 weeks.
11) Body fat thickness in obese adolescents is body fat as measured using calipers, expressed on numerical scale with millimeters (mm).

$$IMT = \frac{BB(kg)}{TB(m^2)}$$

12) Body fat mass obtained by calculating using Parizkova equation often used to determine fat mass in body that is:
    a) Female % BF: 39,032Y-30,084
    b) Male % BF: 32,914Y-21,973
    - % BF: body fat
    - Y= log (thick folds of skin of biceps + thick folds of tricep skin)

Data were analyzed using computer program. The analysis of the research results is descriptively presented as the sum (n) and percentage (%). Normality analysis was performed by Kolmogorov-smirnov test. In the results of normality analysis obtained normal results, then the association analysis is done by linear regression test.

3. Result

There were 33 subjects who met the inclusion criteria, the majority of the subjects were male (60.6%) and 13 (39.4%) of them were female. The mean age of the subjects was 14.21 years with a standard deviation of 0.54 years. The mean body weight of the subjects was 77.66 kg with a standard deviation of 11.18 kg. The mean height of subject was 157,10 cm with standard deviation 8,17 cm. The mean value of IMT is 31.01 with standard deviation was 2.79. Average thickness of biceps fat 3.11 cm with standard deviation 1,1 cm. The average thickness of tricep fat 3.49 with standard deviation 0.71 cm. the body fat mass of the subjects was obtained with a mean of 3.41% and standard deviation of 2.12%. The average value of vitamin D content was 18.41 ng / mL with a standard deviation was 4.20. These characteristics of sample shown in Table 1.

Table 1: Characteristics of research subjects

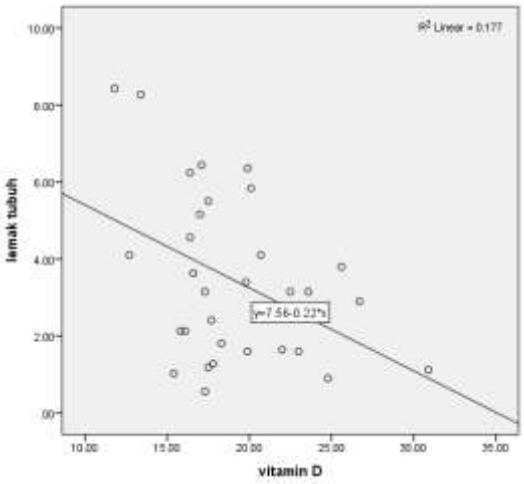
Variable	n=33
Age, mean (SD), (Year)	14.21 (0.54)
Gender (male), n (%)	20 (60.6)
Weight, mean (SD), (kg)	77.66 (11.18)
Height, mean (SD), (cm)	157.10 (8.17)
Body Mass Index, mean (SD), (kg/m2)	31.1 (3.08)
Bicep fat thickness, mean (SD), (cm)	3.11 (1.1)
Tricep fat thickness, mean (SD), (cm)	3.49 (0.71)
Fat mass, mean (SD), (%)	3.41 (2.12)
Levels of vitamin D blood, mean (SD), (ng / mL)	18.41 (4.20)

Normality tests get data in the normal range. Analysis of association between body fat with vitamin D level was done by using linear regression test got value r = -0,421 with value P = 0,015 as we can see in table 2.

Table 2: Association between body fat masses and vitamin D vitamin D

	vitamin D	
	r	p
Body fat masses	-0,421	0,015

Figure 1. Scatter plot association of body fat and vitamin D in adolescent obesity.



4. Discussion

The analysis was performed to all subjects who collected as many as 33 adolescents aged 12 to 15 years who suffer from obesity. The anthropometry data collected includes weight, height, and body mass index (BMI). The majority of subjects are male. The proportion of obesity proportions in male and female was 1.53: 1. The study yielded different results in the proportion of obesity rates by sex, both sexes at risk for obesity.14

Vitamin D is a precursor of hormones and is available in two forms: ergocalciferol or D2 and cholecalciferol or D3. Ergocalciferol or D2 contained in plant foods and some types of fish, cholecalciferol or D3 can be synthesized in the skin humans with the help of sunlight. Humans meet their vitamin D requirements by consuming foods containing vitamin D or by exposure to sunlight for a certain time.15 Vitamin D was first discovered by Mc Collum where it was found to cure rickettes.16

Vitamin D produced in the inactive form, after becoming an active form it can be regarded as a hormone, because there is a structure of molecular branches of cyclopentano perhydrophenantrene ring in the structure of vitamin D. This vitamin structure is similar to the structure found in steroid hormones such as estradiol, cortisol and aldosterone. Vitamin D has a role in the metabolism of calcium in various tissues, so it is said to have hormonal function.15 Vitamin D can function in body's metabolism only in their active form, while the inactive form is the opposite.16

The composition of the human body consists of many components that compose it. This Components include: fat tissue, muscle, bone and water. Body fat composition can be assessed very accurately through the examination of magnetic resonance imaging (MRI) and CT. But this examination is expensive and not practical for field research. Therefore in this study using Parizkova equation which is often used to determine the fat mass in the body.17

Mean vitamin D levels in this study were 18.41 ng/mL, of which 11 (33.3%) of the subjects had vitamin D levels above 20 ng/mL which means having normal levels and as many as 22 (66.6%) subjects experienced vitamin D deficiency. The incidence of vitamin D deficiency was found to be quite high in obese patients compared to normal. Research in the United States to get the incidence of vitamin D deficiency in obese and super obese children were 34% and 49% repectively, while in healthy children only 21% .18 Other studies also support this results, vitamin D deficiency is more common in children who are obese than non-obese children (57% vs 40%).19

Research on the association between body fat mass and blood levels of vitamin D in children and adolescents with obesity has not been widely practiced. Bivariate analysis with linear shown moderate negative association with the value of r: -0.421 with a value of P: 0.015. These results indicate that greater body fat mass associated with lower the vitamin D levels in the blood. As one fat-soluble vitamin, vitamin D will accumulate in fat tissue, causing the level of vitamin D in the blood will decrease. Fatty tissue not only stores vitamin D passively, but also has a role in vitamin D metabolism.
Several studies have found a similar result. Vitamin D has an inverse relationship with BMI and the volume of fat tissue.

Obese children and adolescents with vitamin D deficiency have a higher BMI and thicker fat tissue compared to children with normal vitamin D levels.20 Research in adolescent at 2010 found similar results. Although the subjects in this study were not limited to obese individuals, vitamin D levels were found negatively related to fat mass and other fatty indicators in adolescents.21 In healthy group, body fat mass were among the factors that influenced the incidence of vitamin D deficiency in children. Higher body fat mass had greater risk to suffering vitamin D deficiency.22 Research in adult people gets the same results. There was a strong negative association between serum vitamin D and body fat by measuring visceral fat and subcutaneous fat using computed tomography exchanges and body fat values using dual-energy x-ray absorptiometry. Body weight, body mass index, and adipose tissue size at all sites were significantly lower in women with normal serum vitamin D concentrations than women with lower vitamin D levels.23 In older group, the result were same. Increased BMI and higher body fat percentages were significantly associated with lower serum vitamin D levels in the elderly. This association were primarily found in overweight individuals, and higher percentage of fat, indicating that these people are at high risk of vitamin D deficiency.24 Vitamin D is a fat soluble vitamin, an insoluble group in water. This condition tendency to accumulate and irregularities vitamin D in body fat tissue so that the cause of vitamin D deficiency in obese people.25

Weakness in this research other than the research design in the form of cross-sectional research. Dietary arrangements were also not done so it is possible that the influence of consumed vitamin D with vitamin D levels during the examination. Other factors such as sun exposure may also affect vitamin D levels in the blood of the subjects.

5. Conclusion

The study concluded that there was a moderate negative relationship between body fat mass and serum vitamin D levels in adolescents with obesity, and the relationship was statistically significant.

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