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Relationship between obesity and leptin serum among low socioeconomic primary school children aged 5-7 years

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Abstract

Background Obesity has become a major health problem globally, indicates as an epidemic problem by World Health Organization (WHO). Adiposity rebound period may represent critical period for the development of adiposity. Recent data suggest that, in industrialized countries, people of low socioeconomic group are more likely to be obese than their high socioeconomic counterparts. Level of serum leptin was reported to be higher in obese subjects. There has been lack of data regarding leptin serum level in Indonesian obese children.

Objective This study aimed to investigate leptin serum level in low socioeconomic obese children.

Methods This was a cross sectional study performed in Tuminting District, Manado. Obesity was defined based on body mass index for Asia-Pacific condition, i.e., grade I obesity (BMI 25-29.9 kg/m^2), grade II (BMI 30-40 kg/m^2), and grade III (BMI > 40 kg/m^2. Low socioeconomic status was determined based on Government's program Cash Direct Aid Program. loBod sample was obtained from inclusion subjects, consisted of leptin serum.

Results Fifty-two low socioeconomic obese children were eligible with age ranged between 5 to 7 years. They were divided into grade I obesity (43 or 82.7%), and grade II (9 or 17.3%). The lowest leptin blood level was 10,291 pg/mL, while the highest was 41,500 pg/dL. All girls had normal serum leptin level; in contrast all boys had increased serum leptin level.

Conclusions Leptin level increased in those subjects whose BMI increased. **[Paediatr Indones. 2010;50:166-9]**.

Keywords: *children, obesity, low socioeconomic, leptin*

Obesity has become a major health problem globally. World Health Organization (WHO) indicated obesity as epidemic problem. Obesity has increased dramatically among children and youth all over the world. Surveys indicate that the number overweight and obese children age 6 to 17 years has doubled within the last three decade.[1-2] Several sources of data suggest that the time of adiposity rebound occurs at age 5 to 7 years may represent critical period for the development of subsequent adiposity. The body mass index (BMI) increases in the first year of life and subsequently decreases. Beginning at 5 years, BMI again begins to increase. The time at which the second increase occurs has been called the period of adiposity rebound.[3]

There has been a strong interest in studying the relation between socioeconomic status and obesity. Previous studies have shown that the association between socioeconomic and obesity may vary by population, sex and age. In general, data indicate that in industrialized countries, people of low

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socioeconomic groups are more likely to be obese than their high socioeconomic counterparts, whereas high socioeconomic groups are at increased risk for obesity in developing countries.[4-7] There has been lack of data regarding leptin serum level in Indonesian obese children.

Leptin is a product of the ob gene located on chromosome 7q31.3, is a 16 kDa protein secreted by differentiated adipocytes. It acts on the hypothalamus by suppressing food intake and stimulating energy expenditure.[8,9] In human subjects, a high correlation between the body fat content and serum leptin has been found.[10] In addition, level of serum leptin was reported to be higher in obese subjects than in those with normal weight. This renders a state of leptin resistance in obese subjects.[11,12] To our knowledge, there has been lack of data regarding leptin serum level in Indonesian obese children. This study was aimed to measure leptin serum level in low socioeconomic obese children and also to evaluate the relationship between leptin and BMI in order to be able to elaborate the etiology of childhood obesity.

Methods

Subjects were low socioeconomic obese primary school children who lived in Tuminting District, Manado. This study was performed from April to August 2009. The number of subjects was calculated using estimation of proportion and 50 subjects were needed. Obesity was determined using BMI based on Asia-Pacific condition. BMI was defined as weight in kilograms divided by the square of height in meters (kg/m^2). Obese was divided into 3 groups: obesity grade I (BMI 25-29.9 kg/m^2), grade II (BMI 30-40 kg/m^2) and grade III (BMI > 40 kg/m^2).[13,14] Low socioeconomic status was determined in accordance with Government's program for the poor, called Cash Direct Aid Program.

Blood specimen consisted of leptin serum were drawn from the subjects in the morning after overnight fast. Informed consent was obtained from parents. Leptin serum was separated and kept frozen at -20°C until analysis. Leptin serum was measured using the Quantikine® human Leptin Immunoassay, designed by R&D Systems, USA. The Quantikine® is a 3.5 hour solid phase ELISA to measure soluble human leptin in cell culture, serum and plasma. All calculation was made with the statistical program SPSS version 17.

Results

Fifty-two low socioeconomic obese primary school children were eligible, with age ranged between 5-7 years. Forty three (82.7%) children belonged to grade I obesity and 9 (17.3%) belonged to grade II obesity. Of the 52 subjects, 37 subjects were boys.

The lowest leptin blood level was 10,291 pg/dL, while the highest was 41,500 pg/dL. **Table 1** shows the characteristic of subject's leptin serum. Out of 52 subjects, 37 subjects had increased leptin serum level and surprisingly all of them were boys. All of 15 girls had normal leptin serum level.

Table 1. Characteristic of boys' and girls' leptin serum

Leptin characteristic		Boys	Girls
Minimum	(pg/mL)	11.361	10.291
Maximum	(pg/mL)	41.500	36.871
Normal	(pg/mL)	0	15
Increased	(pg/mL)	37	0

Normal level: 2.205-11.149 pg/mL (boy) and 3.877-77.273 pg/mL (girl)

Table 2. Comparison of obese groups and leptin serum

Obese groups	Mean (pg/mL)	SD (pg/mL)	t-test	P
Grade I	18.079	4.856	-5.484	< 0.001
Grade II	28.751	7.237		

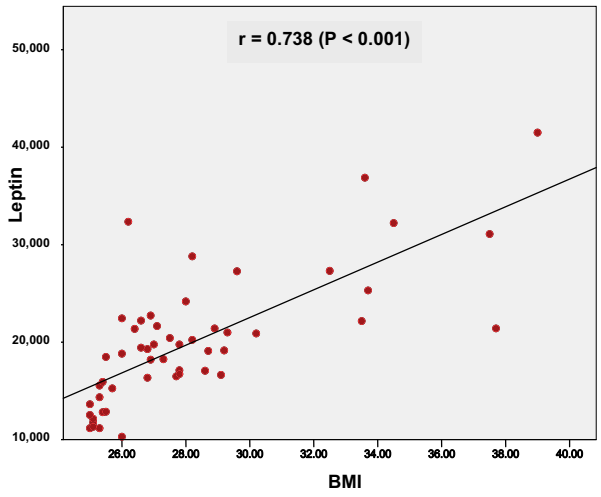

Figure 1. Relationship between serum leptin and BMI

Comparison between obese groups and leptin serum was performed using t-test. **Table 2** shows comparison of obese goups and leptin serum. The relationship between leptin serum and BMI was investigated by Pearson's correlation. **Figure 1** shows the concentrations of serum leptin significantly correlated with BMI ($r = 0.738$; $P < 0.001$).

Discussion

Our data clearly show a positive correlation ($r = 0.74$) between body mass index and serum leptin levels in obese children of low socio-economic status. Obesity has become a global epidemic and it is still increasing in both industrialized and developing countries.[2] Specifically, the development of obesity has been identified in children. Many observations suggest that two and possibly three critical periods in childhood exist for the development of obesity and its complications. These include gestation and early infancy, the period of adiposity rebound that occurs between age 5 to 7 years, and during adolescence period. Obesity that begins at these periods appears to increase the risk of persistent obesity and its complications.[3] The existence of critical periods for the development of adiposity and its sequelae may also serve to focus preventive and therapeutic efforts on developmental stages when these efforts are likely to be most cost effective.[15] In our study, we focused in obese primary school children age 5 to 7 years corresponding to the ages during which the onset of obesity is most likely leading to either adult obesity.

The impact of socioeconomic status seems to be a decisive factor in the development of obesity. For instance, in developed nations, obesity is inversely correlated with socioeconomic levels, while in developing nations obesity has been positively correlated with socioeconomic.[4] In the past few decades, however, many developing societies have experienced elevated rates of obesity. Many factors may account for this, including a rapid change in dietary habits with a tendency toward wide scale accessibility of low-cost, high-calorie, low-nutrition foods; progressive decline of physical activity at home and school; and growth of motorized public and private transportation and sedentary lifestyles.[16] In our study, we focused in low socioeconomic obese children in Tuminting District, Manado. The finding suggests an association between higher adiposity and low socioeconomic in this study, which may be related to unhealthy food choices in the children living and attending schools in those low socioeconomic neighborhoods. To explain this finding, dietary analysis and lifestyle record are needed.

Leptin levels reflect not only the amount of fat stored in the adipose tissues, but also energy imbalance; prolonged fasting, for instance, substantially decreases leptin levels, whereas overfeeding greatly increases them. In human, a highly significant correlation between body fat content and leptin serum concentration has been observed. In general obese human have high leptin levels. The relationship of leptin to other form of obesity can be inferred by measurement of leptin serum level. An increased in plasma level suggest that obesity is the result of leptin resistance. A low or normal plasma concentration of leptin in the context of obesity suggests a possible defect in the synthesis and/or secretion of leptin.[17] In this study most of the subjects had high level of leptin, suggesting that this phenomenon is associated with insensitivity to leptin. To explain why the entire girl subjects in our study had normal leptin level, where as most of boys subject had high leptin level, is not so easy. The mechanism of this sexual dimorphism is unknown. It is possible that there are differences in the clearance of leptin from the blood and/or variations in the transport system to the brain's leptin receptor site that are gender dependent.[18]

Although leptin predominantly involved in the hypothalamic control of body weight, leptin receptor are widely distributed on endothelial cells. Leptin has also been shown to induce oxidative stress in endothelial cells, which could contribute to vascular pathology.[19]

The limitation in this study was that serum leptin was taken early in the morning after overnight fast. As have been shown in previous study, serum leptin levels decreased rapidly during the early morning, thus assessment of leptin in this time may be potentially confounded by spontaneous variations. It is suggested that to minimize the confounding effect from diurnal rhythms, the sampling should be taken within 30 minute between 10 AM and 4 PM.[20] However, ideal time of blood sampling was difficult to achieve because it is very hard to do 12 hours fasting for the subjects particularly those at very young age.

In conclusion, we found leptin level increased in those subjects whose increased increased BMI. It is necessary to encourage the participation of structured programs for physical activity during and after school.

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