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Original Article

Waist circumference and insulin levels in obese children

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Abstract

Background Childhood obesity is one of the most serious public health challenges of the 21st century. Its prevalence has increased at an alarming rate. Overweight and obese children are prone to obesity in adulthood and to developing non-communicable diseases (NCDs) like diabetes and cardiovascular diseases at a younger age. Increased waist circumference has been shown to contribute to the risk of metabolic syndrome in obese adults.

Objective To assess for a correlation between waist circumference and insulin level in obese children.

Methods In this cross-sectional study, obese children aged 6-10 years were included by consecutive sampling. We excluded children with infectious disease, malignancy, dyslipidemia, type 2 diabetes mellitus, or those who had not fasted before the blood draw. Subjects underwent waist circumference and fasting blood glucose measurements. Serum insulin levels were examined by enzyme-labeled chemiluminescent immunometric assay, after subjects had fasted for 10-14 hours. Data were analyzed by correlation analysis.

Results Subjects had a mean waist circumference of 80.2 (SD 7.2) cm and mean insulin level of 10.70 (SD 7.5) μIU/mL . Pearson's correlation test revealed a significant, moderately positive correlation between waist circumference and elevated insulin level (r=0.45; P=0.006).

Conclusion Waist circumference and insulin level have a significant, moderate, positive correlation in obese children. As such, waist circumference may be a simple method for early detection of hyperinsulinemia, as a risk factor for metabolic syndrome. **[Paediatr Indones. 2017;57:194-7 ; doi: http://dx.doi.org/10.14238/pi57.4.2017.194-7]**.

Keywords: *waist circumference; insulin level; obese; children*

Childhood obesity is one of the most serious public health challenges of the 21st century. The problem is global and is steadily affecting many low- and middle-income countries, particularly in urban settings. The prevalence has increased at an alarming rate. Globally, in 2013 the number of overweight children under the age of five, was estimated to be over 42 million.[1] The 2013 Indonesian National Health Survey (Riskesdas) found that the prevalence of obesity in children aged 5-15 years was 8.8%,[2] while the prevalence of obesity in the pediatric outpatient clinic at Sanglah Hospital was 21.7%.[3]

Childhood obesity is associated with a higher chance of premature death and disability in adulthood. Overweight and obese children are more likely to remain obese into adulthood and to develop non-communicable diseases (NCDs) like diabetes and cardiovascular diseases at a younger age.[4,5] Recent study has shown the importance of

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hyperinsulinemia, insulin resistance, and impaired glucose tolerance in promoting atherosclerosis. It is also well established in adults that obesity is related to hyperinsulinemia and insulin resistance although the precise mechanism underlying the relationships remains controversial.[4-6]

Indicators of body composition are strongly associated with metabolic changes, and it is important to verify their relationship with components of metabolic syndrome and with insulin resistance.[2,7,8] The body mass index (BMI) is the tool most commonly used to estimate overweight and obesity in children and adults. However, BMI has its limitations because increases may be related to increased fat-free mass. Also, the relationship between BMI and fat varies according to age, sex, and degree of sexual maturity. At the end of the 1990s, waist circumference (WC) was noted to be a simple screening tool, as abdominal fat may be a better predictor cardiovascular risk.[9,10]

Waist circumference and waist-to-hip ratio (WHR) are indices of body fat distribution, and have been associated with morbidity and mortality in adults. However, their prognostic value in children has been inconclusive and no data are available on tracking from childhood to adulthood.[6] Thus, we examined a possible correlation between waist circumference and insulin level in obese children.

Methods

This cross-sectional study was conducted from August to December 2015 in five elementary schools in Denpasar, Bali. The study was approved by the Ethics Review Board at Udayana University, Bali. Subjects were obese children aged 6–10 years and selected by consecutive sampling. Sample size was calculated based on a correlation study formula with type one error of 5% ($Z\alpha=1.96$), and type 2 error of 20% ($Z\beta=0.842$). The minimal correlation (r) was 0.42. The minimum required number of subjects was calculated to be 42 children.

Subjects included in this study were children aged 6-10 years and got the informed consent from their parents to be involved in this study. Children with infectious disease, malignancy, type 2 diabetes mellitus, or those who had not fasted before blood specimens were obtained, were excluded.

Anthropometric measurements included body weight, height, and waist circumference. Waist circumference was measured using a meter tape at the midpoint between the lowest rib and the end point of the iliac crest. Body mass index (BMI) was calculated based on body weight in kilograms divided by height in meters-squared (kg/m2). Obesity was determined using the WHO 2006 growth standard chart. Children were classified as obese for BMI Z scores ≥ +2 SD. Fasting insulin levels were determined from subjects' serum specimens by Prodia Laboratory after subjects had fasted for 10-14 hours. An enzyme-labeled chemiluminescent immunometric assay (*Immulite*® 2000 Analyzer Systems, Siemens Healthcare Diagnostics Products Ltd., Llanberies, Gwynedd, United Kingdom) was used to measure serum insulin, with results expressed in a numeric scale of microunit units/mL, to the nearest 0.1 microunit/mL.

Data was processed and analyzed with *SPSS 16* software. Descriptive data were presented in text and tables. Pearson's correlation test was used for data a nalyses.

Results

During the study period, 1,946 elementary school students aged 6-10 years underwent anthropometric screening, of whom 170 were classified as obese. One hundred twenty-four children refused to participate in this study, and one child was excluded because his insulin level was too low. Characteristics of subjects are shown in **Table 1**. Mean age of children in this study was 8.8 years, mean of waist circumference was 80.2 cm, and mean of insulin level was 10.7μIU/mL. We found a significant, moderate, positive correlation between waist circumference and insulin level (**Table 2** and **Figure 1**).

Table 1. Characteristics of subjects

Characteristics	N=45
Males, n(%)	29 (64)
Mean age (SD), years	8.8 (1.3)
Mean body weight (SD), kg	45.9 (9.2)
Mean body height (SD), cm	136.6 (9.4)
Meang waist circumference (SD), cm	80.2 (7.2)
Mean body mass index (SD), kg/m^2	24.4 (2.5)
Mean insulin level (SD), μIU/mL	8.8 (1.3)

Table 2. Pearson's correlation test results

		Waist circumference
Insulin level	R	0.45
	P	0.006

Discussion

We observed that more male subjects (64%) were obese than female subjects. The prevalence of obesity in Medan elementary school children in 2007 was 60% in males and 39% in females.[11] Lone *et al.* also reported that of 262 obese children aged 4-10 years, 60% were male and 40% were female.[5] Dewi *et al.* reported that more male (83%) than female children in an urban area were prone to obesity.[12]

Obesity in childhood is associated with risk factors of cardiovascular disease later in life. In a population-based study, obesity during childhood was the strongest risk factor for metabolic syndrome (MetS). MetS is defined as a combination of conditions, including hyperlipidemia, insulin resistance, hyperglycemia, hypertension, and abdominal obesity, which exist in a constellation of interconnected physiological, biochemical, clinical, and metabolic factors.13 Abdominal fat is considered to be the key determinant of metabolic risk, since the pro-inflammatory adipokines secreted by visceral fat are related to increased blood pressure, dyslipidemia, and insulin resistance.[14] Various studies have shown that obese children have low HDL cholesterol, high triglycerides and insulin levels, but normal blood glucose levels, suggesting that glucose intolerance may develop later than other syndrome abnormalities.[15] Waist circumference is an indicator of central obesity, and is considered to be a risk factor for cardiovascular disease, stroke, and type 2 diabetes in adults.

Romero-Velarde *et al.* reported that mean insulin level and waist circumference in obese children were 16.7 μIU/mL and 86.1 cm, respectively. Waist circumference had a significant positive correlation with insulin level in obese children (r=0.58).10 Similarly, Bedogni *et al.* suggested that waist circumference was the best single predictor of insulin level in obese children (r=0.16), compared to BMI (r=0.09).6 In addition, Lone *et al.* found that mean insulin level and waist circumference in obese children were 12.7 μIU/mL and 70.1 cm, respectively.[5] Also, we found mean insulin level of 10.7 μIU/mL and mean waist circumference of 80.2 cm. Waist circumference had a positive correlation with insulin level in obese children in our study.

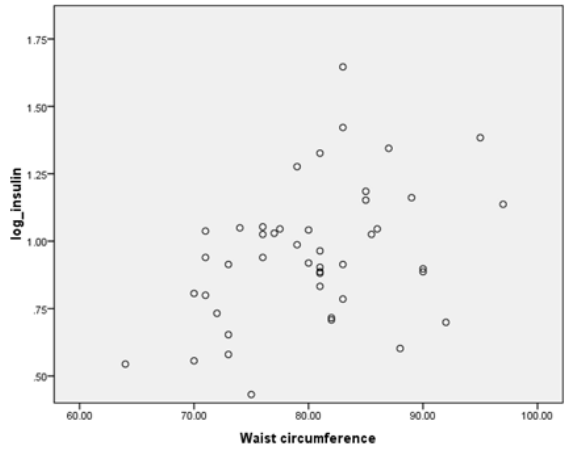

Figure 1. Scatterplot of waist circumference and insulin level

In conclusion, there is a moderately positive correlation between waist circumference and insulin level in obese children. As such, waist circumference can be used as an early detection method for the occurrence of hyperinsulinemia and insulin resistance as risk factors of metabolic syndrome.

Conflict of Interest

None declared.

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