



Original Research Article

Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) in Male Adolescent with Obesity at Rajawali Christian Catholic School in Makassar Municipality, Indonesia

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ABSTRACT

Introduction: Obesity is a pathological condition characterized by accumulation of adipose tissue (fat) under the skin, whereas obesity is a major risk factor of insulin resistance by looking at levels of HOMA-IR, this study aims to find out the differentiation of HOMA-IR level among obese teenagers at Senior High School of Rajawali Christian Catholic in Makassar Municipality.

Materials and Methods: Comparative study with cross sectional approach was conducted in urban area in June 2010 with 39 male students. It was divided into three groups: obesity, overweight, and normoweight, obesity defined based on body mass index (BMI) and waist circumferences (WC) international standards, which viewed by age level, cut off point of BMI for overweight and obesity student with age 15 years are ≥ 23.29 and ≥ 28.30 respectively. Then student overweight and obesity with age 16 years old are ≥ 23.9 and ≥ 28.88 . Students overweight and obesity with age 17 years old are ≥ 24.46 and ≥ 29.41 . Student overweight and obesity with age 18 years old are ≥ 25 and ≥ 30 . For male a student who has waist circumference ≥ 90 cm categorized abdominal obesity (AO). Data were analyzed by Kruskal Wallis and correlation lambda used SPSS software.

Result and Discussion: The results showed that proportion of level HOMA-IR in the obese group are 23%, while overweight, normoweight are 41% and 36% respectively. There are significant differences between BMI and WC toward HOMA-IR whereas P value $p = 0.000$ and $p = 0.000$, OR 0.31 and OR 0.07 respectively.

Conclusion: The increasing level of HOMA-IR in male adolescents with high BMI and WC indicated that insulin resistance had been occurred, but when we look at the correlation between BMI and the WC is still very weak

Key words: Obesity, Insulin Resistance, HOMA-IR.

INTRODUCTION

To date overweight and obesity both child and adulthood increasing significantly and become one of the most public health

issue. Previous studied stated that obesity has become a pandemic, with more than a billion people affected worldwide. ^[1] And it was increase in both developed and

developing countries. [2] In the US obesity adolescents aged 12-19 years has increased almost 3.5 folds over a period of 24 years (from 5.0% in 1976-1980 to 17.4% in 2003-2004). [3] Children with age 9-12 will gain more weight then continued in young adulthood [4] whereas male children/ adolescents more likely to distribute excess body fat in intra-abdominal compartment than female. [5]

Indonesia National Health Research Survey confirmed that prevalence of overweight in Indonesia with 6-18 years old up to 30%. [6] However, the prevalence of overweight and obesity in urban children was 15 times higher than that of rural. [7]

The adverse health consequences from obesity in children are insulin resistance and type 2 diabetic then become stronger predictor of mortality risk from cardiovascular diseases. [3] But other study emphasize that the most commonly morbidities occur in obese adolescences to the short-term complication is insulin resistance (IR) [8] which is characterized by a decreased ability of insulin to stimulate the use of glucose by the muscle and adipose tissue, where the suppression of lipase controlled by insulin is impaired. It's because of excessive supply of free fatty acids further affects glucose transportation in the skeletal muscles, and inhibits insulin activity. [9] To identify insulin resistance in children and adolescent Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) is widely validated clinical and epidemiological tool. [10] This study aims to identify differentiation of HOMA-IR level in obese adolescents who was studying at Rajawali Christian Catholic School in Makassar Municipality.

MATERIALS AND METHODS

This study was conducted on June 2010 with 39 male students at Rajawali Christian Catholic School in Makassar

Municipality. This was comparative study with cross sectional approach. Study was initiated after obtaining approval from the Institutional Scientific Committee and the Institutional Ethics Committee Hasanuddin University.

Questionnaire Survey: this questionnaire proposed to elicit demographic data including age and sex.

Anthropometric measurements: Before conducted measurement all instruments were standardized and the balances were zero calibrated, body mass index (BMI) of the students was calculated using the equation:

$$\text{BMI} = \text{Body weight (Kg)} / \text{Height (m)}^2$$

The height was measured with stadiometer. Subjects were made to stand barefoot on the flat surface, the sides, the head, back, buttocks hanged arms freely, and heels in contact with the vertical board then height recorded to the nearest 0.1 cm.

The weight was measured in kilograms using standardized bathroom weighing machine with the subject standing erect on centre of the platform, with the body weight evenly distributed between both the feet with light clothing and looking straight. The weight was recorded to the nearest 0.5 kg.

International cut off points for body mass index for overweight and obesity adolescent by sex between 2 and 18 years was used as standard of measurement in this study. [11]

WC was measured midway between the lowest rib and the superior border of the iliac crest with an inelastic measuring tape at the end of normal expiration to the nearest 0.1 cm. [12]

Cut off point of BMI for overweight and obesity student with age 15 years are ≥ 23.29 and ≥ 28.30 respectively. Then student overweight and obesity with age 16 years old are ≥ 23.9 and ≥ 28.88 . Students overweight and obesity with age 17 years

old are $\geq 24.46 \geq 29.41$. Student overweight and obesity with age 18 years old are ≥ 25 and ≥ 30 . For male a student who has waist circumference ≥ 90 cm categorized abdominal obesity (AO) [11]

Homeostasis Model Assessment of Insulin Resistance (HOMA-IR): HOMA-IR was calculated using the equation: $HOMA-IR = \text{Fasting insulin } (\mu\text{U/mL}) \times \text{Fasting glucose } (\text{mg/dL}) / 405$. [12]

Statistical Method

Data was input into Microsoft excel sheet and analyzed with Kruskal-Wallis test in order to find the differentiation level of HOMA-IR among three groups of adolescents using SPSS version 10.5 software. Statistical tests like percentages, measures of central tendency, measures of dispersion. The statistical significance was evaluated at 95% confidence level ($p < 0.05$)

RESULT

Table 1. Characteristic of Respondent

Variables	n	Mean	SD
Age (year)	39	16.43	0.754
Weight (kg)	39	73.67	16.98
Height (cm)	39	169.03	170.0
BMI (kg/m^2)	39	25.62	5.102
WC (cm)	39	90.41	15.53
Homa -IR	39	1.323	1.195

The descriptive of respondents was described based on age, weight, height, BMI, WC and HOMA-IR mean, which had reported on the table 1.

Table 2. Distribution of BMI and WC in Adolescent

Variables	N	%
BMI		
Obesity	9	23
Overweight	16	41
Normoweight	14	36
WC		
Central Obesity	19	49
Non Obesity	20	51

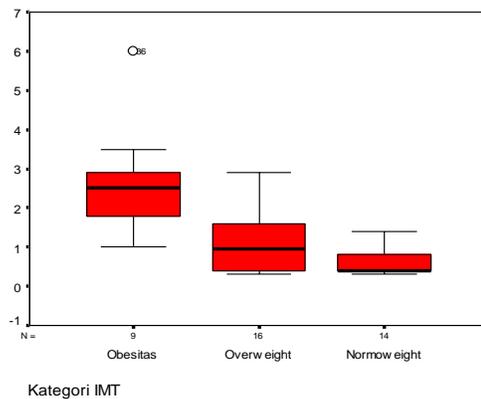
Table 2 shows the frequency of study subjects according to the categories of BMI (weight/height^2) and WC.

Table 3. Differentiation between BMI and WC in Adolescent

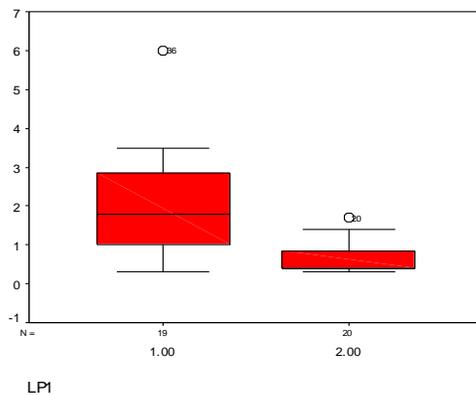
Variables	HOMA-IR		p-value
	n	Mean+SD	
BMI			
Obesity	9	2.66 ± 1.464	0.00
Overweight	16	1.193 ± 0.891	
Normoweight	14	0.607 ± 0.347	
WC			
Abdominal Obesity	19	2.042 ± 1.335	0.00
Normal	20	0.64 ± 0.40	

Table 3 shows the differentiation between categories of BMI (obesity, overweight and normoweight) and Waist circumference toward level of HOMA-IR in Adolescents.

The highest level of HOMA-IR among adolescents was found in the highest of BMI level or categorized as obesity (2.66, 1.46). While adolescent who has highest waist circumference or categorized as abdominal Obesity had found the highest level of HOMA-IR (2.04, 1.33).



Picture 1. Level of HOMA-IR based on BMI (Obesity, overweight and normoweight)



Picture 2. Level of HOMA-IR based on Waist circumference (Abdominal obesity and normal)

DISCUSSION

Studies now indicate many of the components associated with insulin resistance are present in children and adolescents. Insulin resistance attributed to many the development of numerous physical findings that have serious health consequences such as overweight, hypertension, hyperlipidemia, cardiovascular disease, acanthosis nigricans (AN), type 2 diabetes and lead to the syndrome metabolic as well. Therefore detecting early evidence of insulin resistance in children and adolescents can have a preventive effect on the any complications of diseases. [13]

In this study researcher significantly found the increase level of HOMA-IR in male obese adolescents then followed by male overweight adolescents, while male adolescent with normoweight have not display the increase of HOMA-IR level. Compared between BMI and WC, level of HOMA-IR in male obese adolescents did not give significantly differentiation. It just shows that obesity become major factor of insulin resistance that marked by increase of HOMA-IR level. It was relevant to previous studied who mentioned that obesity is the most prevalent pathophysiological cause of insulin resistance (IR) that is defined as a diminished tissue response to insulin-mediated cellular actions, referring to whole-body reduced glucose uptake in response to physiological insulin concentration. [14] Conversely, it has been claimed that at least 30% children under 12 year of age display insulin resistance and it's usually induced by fat deposited intracellularly, mainly in adipose and muscular tissues. [15] Another previous studied have shown that obesity during childhood is associated with decreased insulin sensitivity and increased circulating insulin levels. They have also shown that

these abnormalities often persist into young adulthood. Insulin resistance is an important factor in the development of type 2 diabetes. [16]

Adipose tissue assumed as major factor that has contribute to the insulin resistance, it's relevant to the studied that said adipose tissue seems to play a key role in the pathogenesis of insulin resistance through several released metabolites, hormones and adipocytokines that can affect different steps in insulin action. Another factor that contribute to the insulin sensitivity is adipocytes, it's produce non-esterified fatty acids, which inhibit carbohydrate metabolism via substrate competition and impaired intracellular insulin signaling. [17] Adiponectin is one of the most common cytokines produced by adipose tissue, with an important insulin sensitizing effect associated with anti-atherogenic properties. Whereas obesity is generally associated with an increased release of metabolites by adipose tissue, levels of adiponectin are inversely related to adiposity. Therefore, reduced levels of this adipocytokine has been implicated in the pathogenesis of insulin resistance and metabolic syndrome. [17]

Insulin stimulates glucose uptake into the cell tissue normally, with insulin resistance, tissue has decreased ability to respond to the action [13] and it could lead the children to adverse health consequences such as elaborated before.

Insulin resistance represents a serious and common complication of obesity during childhood and adolescence. A timely diagnosis and an appropriated prevention and treatment of obesity and insulin resistance are required in order to reduce the associated risk of metabolic and cardiovascular complications. Greater efforts are therefore required in order to avoid obesity and the associated insulin resistant status seriously compromising the

health of our children and the future of our societies. ^[17]

CONCLUSION

In the present study researcher significantly found that the increase of BMI and WC value in male adolescent followed by increase of HOMA-IR level. Homeostasis model assessment of insulin resistance (HOMA-IR) is a sign to identify sensitivity of insulin and adolescent with high BMI and WC has high risk to suffer with insulin resistance.

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