Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2014; 2(6H):3404-3408 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com **DOI:** 10.36347/sjams.2014.v02i06.112

Research Article

Components of metabolic syndrome and hyperuricemia, in obese adolescent in Minahasa North Sulawesi province

Aaltje E. Manampiring*[1],Suryani As'ad[2], Rosdiana Natsir[3], Sarah M. Warouw[4]
[1]Department of chemistry, faculty of medicine, Sam Ratulangi university Manado Indonesia.
[2]Department of Nutrition, faculty of medicine, Hasanuddin university Makassar Indonesia.
[3]Department of biochemistry, faculty of medicine, Hasanuddin university Makassar Indonesia.
[4]Deparment of pediatrics, faculty of medicine, Sam Ratulangi university Manado Indonesia.

***Corresponding author**
Aaltje E. Manampiring
Email: aldakussoy@yahoo.com

Abstract: Metabolic syndrome in obese adolescents continues until adulthood. Metabolic syndrome comprises of components, which are the risk factor for coronary heart disease, type II diabetes mellitus and renal failure. Several studies have demonstrated a close relationship between metabolic syndrome and hyperuricemia. There is limited studies on association between metabolic syndrome and hyperuricemia in adolescents in Indonesia. The aim of this study were to determine the prevalence of metabolic syndrome and hyperuricemia in Minahasa obese adolescents population. This study was a cross-sectional design conducted in senior high school students population in February 2013, involving a total of 160 obese students including 54 males and 106 females, aged 13-18 years. Antopometric measurements including height measurement (HM), body weight (BW), waist circumference (WC) and blood pressure and laboratory tests such as lipid profile, plasma glucose level and uric acid levels. Determination of metabolic syndrome using the IDF criteria, 2007. The participants had to meet ≥ 3 following criteria: WC ≥90 cm for male and ≥ 80 cm for female, triglyceride levels ≥150 mg/dl, male HDL <40 mg/dl,female <50 mg/dl, blood pressure ≥130/85 mmHg, and fasting blood glucose ≥100 mg/dl. Data analyzed using univariate, bivariate and Pearson correlation test. The prevalence of metabolic syndrome within obese adolescents was 41.9%,and more than 55.6% has hyperuricemia. Components of the metabolic syndrome that significantly associated with hyperuricemia; WC, triglycerides and systolic blood pressure (p = <0.05). Over 40% obese adolescent in Minahasa had metabolic syndrome and more than 50% had hyperuricemia. The results of this study provides evidence for prevention against the risk of degenerative diseases morbidity and management among obese adolescents.
Keywords: Metabolic syndrome, obesity, hyperuricemia.

INTRODUCTION

Obesity is a major nutritional problem, not only in adults but also in children and adolescents, both in the developed and developing countries. According to data from RISKESDAS 2010 [1], the prevalence of obesity among children 5-7 years was 19.1%. In 2013 [2] the prevalence of central obesity in Indonesia was 26.6%, and North Sulawesi province was the most prevalent in Indonesia. The prevalence of obesity has increased along with the increasing in the incidence of metabolic syndrome [3].

Metabolic syndrome is also known as insulin resistance syndrome or syndrome X is a cluster of condition as risk factors that contribute to increase degenerative diseases such as cardiovascular disease, type II diabetes mellitus, renal disease and atherosclerosis. Metabolic syndrome is a non-communicable disease, its prevalence increasing worldwide both in adults, children and adolescents.The prevalence of metabolic syndrome in obese adulthood was 40.2%. National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) reported the prevalence of metabolic syndrome in adolescents has increased from 4.2% in the period 1988-1992 to 64% in the period 1999-2000. In Japan, 17.7% of obese children had metabolic syndrome [4]. The prevalence of metabolic syndrome in Chinese adolescent was 32.2%. [5]. Components of metabolic syndrome in adolescents resemble the criteria in adults. International Diabetes Federation (IDF) in 2007 stated that metabolic syndrome in adolescents Metabolic syndrome is defined in patients having three or more of the following:

1. Central obesity as measured by the waistcircumference (someone in asian population with a waist circumference; males greater than 90 cm; females greater than 80 cm)

2. Hypertriglyceride (triglyceride levels ≥150 mg/dl) or are in the specific treatment for fat abnormalities.
3. HDL-cholesterol (males: less than 40 mg/dl, females: less than 50 mg/dl) or are in the specific treatment for fat abnormalities.
4. Hypertension (systolic blood pressure ≥130 or diastolic ≥85; in the treatment/have been diagnose with hypertension).
5. Hyperglycemia (blood glucose levels ≥100 mg/dl) or have been diagnose with diabetes mellitus.

IDF criteria (2007) is the most suitable criterion for adolescents in Asia.Various studies have shown that metabolic syndrome has a good correlation with hyperuricemia in adults as well as children and adolescents. Hyperuricemia is abnormally elevated blood level of uric acid. The prevalence of hyperuricemia varies across the world.

In Europe and the Far East often found hyperuricemia. In United States, hyperuricemia found in 2% males, 7% in Spain and 17% in France. There is no definitive data on prevalence of hyperuricemia in Indonesian. Wisesa and Suastika [6] conducted field research on the population in Denpasar Bali and get hyperuricemia prevalence 18.2%. Some studies shown that the morbidity of hyperuricemia plays an important role in cardiovascular disease, hypertension, diabetes mellitus type II [7]. Study in Bali shown that obesity and chronic renal disease was significantly associated with hyperuricemia [8]. According to data in 2013, North Sulawesi was second rank of Type II diabetes mellitus in Indonesia, hypertension in the first order, the fifth most prevalent of heart failure at the age above 15 years, chronic kidney disease in the fourth order and stroke at sixth place.

The purpose of this study was to determine the prevalence of metabolic syndrome in obese adolescents and hyperuricemia in Minahasa.

METHOD

This study was cross-sectional design insenior high school students in Minahasa District in February 2013. A total of 1282 students including 483 males and 812 females aged 13-18 years. The prevalence of obesity was 21.3% (274 students). Inclusion criteria were obese students aged between 13-18 years, willing to be a research participant by signed an agreement (informed concent). Exclusion criteria were: being or have had kidney disease, lung disease, heart disease, blood disorders, skin diseases, and hormonal disorders. Current or past use of diuretic drugs, aspirin, uricosuric, and pyrazinamide acid, pregnan women, unwilling to do blood sampling. A total of 160 people consisting of 54 males and 106 females . Subjects requested to fill the informed consent after receiving consent from their parents. This study approved by the research ethics committee of the medical faculty of Sam Ratulangi University. In this study antropometric measurement including measurement of height (HM) using microtoise, body weight (BW) using electric scale, waist circumference (WC) using the meter gauge. Criteria for obesity based on waist circumference measurements according to the IDF 2007; WC ≥90 for males and ≥ 80 for females. Blood pressure measurement performed when the patient seated quietly for 5 minutes, the upper arm placed on the table. Blood pressure measured 2 times and the average taken as the value of the subjects blood pressure. Laboratory tests are only performed on 160 students for lipid profile (LDL, HDL, total cholesterol, triglycerides) and blood pressure measurement using Nova®mercury sphygromanometer tool. Blood sampling performed after fasting subjects between 10-12 hours. Blood samples were analyzed in clinical laboratory in Manado. Glucose levels of total cholesterol, triglycerides, HDL and LDL were measured using COBAS Miraautoanalyzer.Data were analyzed using SPSS for Windows version 22 for univariate test, bivariate and Pearson correlation test.

RESULTS

In Table 1 it can be seen that the sample aged 13-18 years, WChighly varies (80-122 cm), FBS (fasting blood sugar) highly varies (55-205 g/dL). Lipid profile, HDL (14-28 g/dL), TG (38-289 g/dL), systolic blood pressure (100-160 mmHg), diastolic blood pressure (60-100 mmHg). Uric acid ranged from 2.40 to 10.20 mg/dl.

Table-1: General description of the research subjects.

Variable	Descriptive Analysis			
	n	Minimum	Maximum	Average ± SD
Age (y.o)	160	13	18	16.04 ± 1. 207
WC (cm)	160	80	122	89.83± 8.053
FBS (mg/dl)	160	55	205	79.48 ± 15.143
HDL (mg/dl)	160	14	28	19.89 ± 3.277
TG (mg/dl)	160	38	289	98.44 ± 46.932
SYST (mmHg)	160	100	160	121.52 ± 11.355
DIAST(mmHg)	160	60	100	79.63 ± 7.781
URIC ACID (mg/dl)	160	2.40	10.20	5.5694 ± 1.6218

Information: y.o=years old, WC=waist circumference, FBS=fasting blood sugar, HDL= High Density Lipoprotein, TG=triglycerides, SYST=systole, DIAST=diastole, SD=standard deviation

In Table 2 shown that samples of adolescents have an average age of 16 years. All subjects had central obesity and among them, 33.75% males and 66.25% females.Overall 14.4% subjects had TG ≥150 mg/dL, and the whole subject (100%) consisted of males with HDL <40 mg/dL and females<50 mg/dL. Overall 4.4% of subjects who already had a FBS ≥100 mg/dL, 29.4% with a systole blood pressure ≥130 mmHg and 21.9% with diastole blood pressure ≥85 mmHg. 55.6% of subjects had hyperuricemia.

Table-2: Distribution of samples based on components of the metabolic syndrome and hyperuricemia

Variable	Criteria	Sum (n)	Percentage (%)
WC	Male ≥90 cm	54	33.75%
	Female ≥80 cm	106	66.25%
TG	≥150 mg/dL	23	14.4%
	<150 mg/dL	137	85.6%
HDL	Male <40 mg/dL, Female <50mg/dL	116	72.5%
	Male ≥140 mg/dL, Female ≥50 mg/dL	44	27.5%
FBS	≥100 mg/dL	7	4.4%
	<100 mg/dL	153	95.6%
BP	SYST ≥130 mmHg	47	29.4%
	<130 mmHg DIAST ≥85 mmHg <85 mmHg	113 35 125	70.6% 21.9% 78.1%
URIC ACID	Male ≥6.4, Female ≥4.9 mg/dL	89	55.6%
	Male<6.4, Female<4.9 mg/dL	71	44.4%
MS COMPONENTS	> 1 > 2* > 3 > 4	93 56 9 2	58.125 % 35 % 5.625 % 1.25 %

*Information: WC=waist circumference, FBS=fasting blood sugar, HDL= High Density Lipoprotein, TG=triglycerides, SYST=systole, DIAST=diastole, MS=metabolic syndrome, *Metabolic syndrome risk factors> 2*

Table- 4: Relationship between the metabolic syndrome components and uric acid.

	Correlation with Uric Acid	
	Bivariate	
Variable	Correlation Coefficient (r)	p Value
WC	0.434*	0.000*
TG	0.249*	0.001*
HDL	- 0.068	0.197
FBS	- 0.72	0.184
SYST	0.142*	0.037*
DIAST	0.024	0.384

Information: WC=waist circumference, FBS=fasting blood sugar, HDL= High Density Lipoprotein, TG=triglycerides, SYST=systole, DIAST=diastole

The relationship between components of metabolic syndrome and uric acid levels analyzed using Pearson correlation test, results showed:

1. There was a significant positive correlation between waist circumference and uric acid level (r = 0.434, p = 0.000)
2. There was a significant positive relationship between triglycerides and uric acid level (r = 0.249, p = 0.001)
3. There was a negative relationship between HDL and uric acid, but this relationship was not statistically significant (r = - 0.068, p = 0.197)
4. There was a not statistically significant relationship between FBS and uric acid, (r = - 0.072, p = 0.184)
5. There was a significant positive relationship between systolic and uric acid (r = 0.142, p = 0.037)
6. There was a not statistically significant relationship between diastolic and uric acid, (r = 0.024, p = 0.384) (p> 0.05).

DISCUSSION

All subjects in this study are obese (male with WC ≥ 90 cm and female WC ≥ 80 cm). Obesity that occurs in adolescence deserves attention because will continue to be obese in their adult years. Waist circumference is an indicator of abdominal obesity. Abdominal obesity associated with a chronic metabolic disorder characterized by abnormal cytokine production, an increase in the reactants and inflammatory mediators [9-10]. It is also associated with an increased risk of incident of coronary heart disease, hypertension, diabetes mellitus. All subjects in this study had HDL levels below normal. These results are consistent with the earlier research results on obese children and adolescents in Mexico where HDL cholesterol levels lower than children of normal weight [11]. Study conducted on obese adolescents aged 13-19 years in the Netherlandsgives the same result [12]. Genetic, dietary and physical activity are factors that influence the levels of HDL [13]. Diet affects on HDL levels. Di Renzo et al. reported the effect of consumption of dark chocolate for 7 days in female with abnormal lipid profile.The research results found a significant increase in the levels of HDL cholesterol[14]. The most supported research shown that effects of diet on HDL cholesterol levels were found in a study conducted by Roya et al in adolescents with overweight and obesity. After 4 months of respondents changed diet, which reduces eat-food fast food, breakfast regularly, and increase physical activity at home and school, it turns out there was an increase in HDL cholesterol levels [15]. Physical activity determines HDL cholesterol levels, through stimulation of lipoprotein lipase (LPL) in the surface of skeletal muscle, adipose tissue, and liver. Increased LPL will increase hydrolysis of triacylglycerol (TAG). Triacylglycerol be broken down into free fatty acids and glycerol, at the same time, free cholesterol and phospholipids on the surface of the TAG will come apart. Physical activity also increases the activity of AMP-activated protein kinase (AMPK) and Silent regulator T1 (SIRT1). Increased activity of AMPK and SIRT1 will stimulate peroxisome ploriferator-activated receptor (PPAR) in the liver to increase the synthesis of apo AI. Apo AI that is formed will bind with free cholesterol and phospholipids were separated from TAG to form a new HDL, therefore an increasing blood levels of HDL cholesterol[16]. Twenty five studies reported the effects of aerobic exercise to increase HDL levels, all studies showed that aerobic exercise increases levels of HDL cholesterol significantly[17].

This study showed that 30.6% of obese adolescents had hypertension. The relationship between hypertension and obesity have been reported by researchers, but the mechanism of hypertension due to obesity is still unclear [18]. The three main factors that influence the pathophysiology of hypertension is an autonomous system disorders, insulin resistance and abnormalities in the structure and function of blood vessels [18-19].

Several epidemiological studies show a strong correlation between uric acid levels and metabolic syndrome (its components) in children, adolescents and adults [20-22].

The prevalence of metabolic syndrome in obese adolescents was 41.9% who have ≥3 components of the metabolic syndrome. The prevalence in this study was higher than the similar study in United States reported as 28.7% [23], another study, Braunschweig in 2005 showed the prevalence of metabolic syndrome was 33.3 %, [24] and also higher than the results of research conducted in Semarang, Indonesia that found 31.6% [25].

The prevalence of hyperuricemia in this study was 51.3%. A number of studies have showed a correlation between metabolic syndrome and hyperuricemia among children and adolescents as well as adults [26-28]. The results of this study show the various components of the metabolic syndrome that has a positive correlation with uric acid was waist circumference, triglycerides and systolic blood pressure. The results were consistent with many studies that the positive correlation between uric acid, waist circumference and triglycerides[21, 28-29]. The high prevalence of metabolic syndrome in obese adolescents and hyperuricemia critical to minimize morbidity and mortality from degenerative diseases.

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