Metabolic Syndrome and Its Components in Men

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ABSTRACT

Aim: *report metabolic syndrome and its components in men using modified NCEP ATP III criteria.*

Methods: *subjects were all apparently healthy men coming for routine medical examination to the private clinic and Internal Medicine Clinic of Jaury Academic Hospital October 2002 to January 2003 were asked to participate in this study. Complete physical examination was done to all subjects including BMI, waist circumference, and blood pressure. Blood samples were collected after 12 hour fasting for triglycerides and HDL-cholesterol examination as well as oral glucose tolerance test. As proposed by WHO, Asian adult male waist circumference is abnormal if ≥ 90 cm. Using modified NCEP ATP III criteria, diagnosis of metabolic syndrome is made only if a combination of at least three of the following abnormalities: waist circumference ≥ 90 cm, blood pressure ≥ 130/ ≥ 85 mmHg, triglyceride level ≥ 150 mg/dl, HDL cholesterol level < 40 mg/dl, glucose intolerance including impaired fasting glucose tolerance, impaired glucose tolerance, and diabetes mellitus were found.*

Results: *total number of subjects was 227 men aged between 21-81 years. 127 males (56.4%) fulfilled the criteria of metabolic syndrome. From a total of 151 subjects with waist circumference ≥ 90 cm, 112 subjects (79.2%) fulfilled the criteria, and this gave a relative risk of 11.3 times higher to these subjects compared to those with waist circumference < 90 cm (95% CI 5.76-22.16;* p< *0.0001). By reducing the waist circumference, 178 subjects were found to have WC ≥ 85 cm, and 117 subjects (66.5%) fulfilled the criteria of metabolic syndrome.*

Conclusion: *this study indicates that metabolic syndrome in apparently healthy men is common, especially in those with large WC. Waist circumference > 90 cm may be used as screening tool to detect metabolic syndrome in men.*

Key words: *metabolic syndrome, waist circumference.*

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INTRODUCTION

Many studies have proven that coronary heart disease (CHD) prevention is not solely obtained by reducing LDL cholesterol level but also by involving other risk factors that need special attentions. National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) in 2001 suggested that metabolic syndrome is an important risk factor of CHD and also treatment target after LDL cholesterol (secondary target).[1] Despite its importance, so far there is no agreement on metabolic syndrome criteria for diagnosis. Recently, there are 2 diagnosis criteria that have been used widely: WHO criteria and NCP ATP III criteria.

Different from criteria by WHO, the NCEP ATP III criteria is more simple and practical in general. It is considered metabolic syndrome if there are at least 3 from the following risk factors: central obesity (waist circumference in men >102 cm, women >88 cm), triglyceride level ^{3} ≥150 mg/dl, HDL cholesterol <40 mg/dl in men and <50 mg/dl in women, blood pressure^3 130/85 mmHg, and fasting plasma glucose concentration^3 110 mg/dl.[1]

According to WHO, there have been many reports of this syndrome from all over the world including in several Asian ethnic groups.[2] In the United States of America, 6 years study during 1988-1994 by *National Health and Nutrition Survey* (NHANES) using NCEP ATP III criteria found the prevalence of metabolic syndrome as high as 22% or approximately 47 million people.[3] There is still very rare publication on metabolic syndrome in Indonesia. The aims of the study is to investigate the prevalence of metabolic syndrome in apparently healthy subjects using NCEP ATP III modified criteria: central obesity is diagnosed if WC in men ^{3} 90 cm (adjustment to proposed criteria by WHO for Asian adult male), glucose intolerance includes impaired fasting blood glucose tolerance, impaired glucose tolerance and asymptomatic diabetes mellitus.

METHODS

Subjects were all apparently healthy men who came for routine medical examinations to the private clinic and internal medicine clinic of Jaury Academic Hospital from October 2002 to January 2003. Exclusion criteria were patient with diabetes mellitus, joining in weight reduction program, or receiving lipid lowering drugs. All subjects had careful anamnesis, physical examination including waist circumference (WC), body mass index (BMI), and blood pressure (BP). Blood sample was taken for examination of triglyceride and HDL cholesterol level; and oral glucose tolerance test with 75 gram of glucose after 12 hour fasting. WC was measured in standing position with bare feet and between two legs distance was 25-30 cm. Measurement was done by horizontal line from central point between iliac crist and lower tip of lowest costae in axillary midline. The result were written in centimeter and rounded of to the nearest number. WC was considered abnormal if $^{3} \geq 90$ cm.[4] Triglyceride examination was done by enzymatic method of colorimetric dimension (Dade Behring Inc.) and HDL cholesterol level by cholestetest N HDL method (Daiichi Pure Chemichals co).Glucose tolerance test by 75 gram glucose diluted in water according to WHO protocol and plasma glucose concentration by enzymatic method of glucose oxydase. Diabetes mellitus type 2 asymptomatic was diagnosed if plasma glucose concentration^{3} 200 mg/dl after glucose tolerance test (isolated post challenge hyperglycemia). Diagnosis of metabolic syndrome was established if there were at least 3 from these abnormalities were found: WC$^{3} \geq 90$ cm, hypertension with blood pressure$^{3} \geq 130/85$ mmHg, triglyceride level^{3} $\geq$150 mg/dl, HDL cholesterol level $\leq$ 40 mg/dl, and glucose intolerance or diabetes mellitus. Statistical analysis used SPSS for windows 10.01 and p value based on two tailed test with significant level < 0.05.

RESULTS

Metabolic Syndrome Components in 227 Subjects

At the end of the study, 227 male patients were included whose age between 21-81 years old. Of them, 151 subjects (66.5%) had waist circumference (WC) $\geq$ 90 cm, 112 subjects (49.3%) with hypertension, 133 subjects (58.6%) with high triglyceride level, and 136 subjects (59.9%) with low HDL cholesterol level. Two subjects did not have oral glucose tolerance test because their prior fasting glucose concentration was high (204 mg/dl and 340 mg/dl). From all patients who underwent oral glucose tolerance test, 17 subjects (7.5%) were found to have impaired fasting glucose tolerance, 57 subjects (25.1%) had impaired glucose intolerance and 48 subjects (21.1%) had asymptomatic diabetes mellitus. (Table1)

Table 1. Metabolic Syndrome Components in 227 Study Subject

	Percentage	
	number	%
Waist circumference $\geq$ 90 cm	151	66,5
HDL-C level < 40 mg/dl	136	59,9
Triglyceride level $\geq$ 150 mg/dl	133	58,6
Hypertension	112	49,3
GPT	57	25,1
DM	48	21,1
TGT	17	7,5

HDL = *high-density lipoprotein cholesterol*, GPT=impaired fasting glucose tolerance
TGT = impaired glucose tolerance, DM = diabetes mellitus

Number of Patients with Metabolic Syndrome According to NCEP ATP III Modified Criteria

Of all subjects, it was found that 70 subjects (30.8%) had fulfilled NCEP ATP III criteria. If we use modified criteria, there are 127 subjects (56.4%) included. (Table 2)

Table 2. Number of Patients with Metabolic Syndrome According to NCEP ATP III Modified Criteria

	Metabolic syndrome (SM) according to NCEP ATP III criteria		Metabolic syndrome (SM) according to modified criteria	
	Number	%	Number	%
SM	70	30.8	127	56.4
Non SM	157	69.2	98	43.6
Total	227	100	225*	100

*) 2 subjects did not have oral glucose tolerance test with 75 gram of glucose
SM = metabolic syndrome, NCEP ATP III = *National Cholesterol Education Program Adult Treatment Panel* III

The proportion is different because the patients with impaired glucose tolerance and symptomatic diabetes mellitus were included according to modified criteria which had replaced original NCEP criteria of fasting plasma glucose $\geq$ 110 mg/dl. Of this total number, 82 subjects (54.3%) with hypertension, 91 subjects (60.3%) had high triglyceride level, 98 subjects (64.9%) had low HDL level, 14 subjects (9.8%) had impaired fasting glucose tolerance (GPT), 43 subjects (28.5%) had impaired glucose tolerance (TGT), and 40 subjects (26.4%) had diabetes mellitus. (Table 3)

Table 3. Metabolic Syndrome Components in Men with Waist Circumference ≥ 90 cm

	Percentage	
	Number	%
HDL level < 40 mg/dl	98	64,9
Triglyceride level ≥ 150 mg/dl	91	60,3
Hypertension	82	54,3
TGT	43	28,5
DM	40	26,4
GPT	14	9,8

HDL = *high-density lipoprotein*, GPT = fasting glucose intolerance TGT = impaired glucose tolerance, DM = diabetes mellitus

Number of Patients with Metabolic Syndromes According to NCEP ATP III Criteria in Men with Waist Circumference ≥ 90 cm

Of 151 subjects with waist circumference ≥ 90 cm, we found 60 subjects (39.7%) had two other risk factors or in other words had fulfilled the criteria for metabolic syndrome according to NCEP (table 4). Waist circumference ≥ 90 cm identified subjects who fulfilled the criteria according to NCEP ATP III with sensitivity of 85.7% and specificity of 42 %. Subjects with waist circumference ≥ 90 cm had relative risk (RR) 4.4 times higher to have metabolic syndrome according to NCEP ATP III criteria compared to those whose waist circumference < 90 cm (95% CI 2.08-9.12; p<0.0001). (Table 4)

Tabel 4. Metabolic Syndrome According to NCEP ATP III Criteria Compared to Man Whose Waist Circumference ≥ 90cm

		Metabolic syndrome (SM) according to NCEP ATP III criteria		Total
		SM	non SM	
WC ≥ 90 cm	number	60	91	151
	%	39.7	60.3	100
WC < 90 cm	number	10	66	76
	%	13.2	86.8	100
	Total	70	157	227

OR = 4.352; 95% Confidence Interval = 2.08 – 9.12; *p*< 0.0001

Number of Patients with Metabolic Syndromes Using Modified Criteria in Men with Waist Circumference ≥ 90 cm

Of 151 subjects with waist circumference ≥ 90 cm, we found 112 subjects (79.2%) had two other risk factors or in other words had fulfilled the criteria for metabolic syndrome according to modified criteria (table 5). Waist circumference ≥ 90 cm identified subjects who fulfilled the modified criteria with sensitivity of 88.2% and specificity of 60.2 % compared to NCEP ATP III criteria. Subjects with waist circumference ≥ 90 cm had relative risk 11.3 times higher to have metabolic syndrome according to modified criteria compared to those whose waist circumference < 90 cm (95% CI 5.76-22.16;p<0.0001). (Table 5)

Table 5. Number of Patients with Metabolic Syndromes Using Modified Criteria in Men with Waist Circumference ≥ 90 cm

		MS according to modified criteria		Total
		SM	Non SM	
WC ≥ 90 cm	number	112	39	151
	%	79,2	25,8	100
WC < 90 cm	number	15	59	74
	%	20,3	79,7	32,9
	Total	127	98	225

OR = 11,296; 95% Confidence Interval = 5,76 - 22,16; *p*< 0,0001

Number of Patients with Metabolic Syndrome According to NCEP ATP III Criteria in Men with Waist Circumference ≥ 85 cm

By reducing waist circumference criteria to ≥ 85 cm, we found 178 subjects with waist circumference ≥ 85 cm. of this number, 65 subjects (36.5%) had at least two other risk factors or fulfilled criteria NCEP ATP III. Waist circumference criteria ≥ 85 cm identified subjects with metabolic syndrome with sensitivity of 92.9% but relatively low specificity (28.0 %). Subjects with waist circumference > 85 cm had relative risk 5.1 higher to have at least other risk factors or fulfilled metabolic syndrome criteria by NCEP ATP III compared to those with waist circumference < 85 cm. (95% CI 1.91-113.41; p<0.0001). (Table 6)

Table 6. Number of Patients with Metabolic Syndrome According to NCEP ATP III Criteria in Men with Waist Circumference ≥ 85 cm

		Metabolic syndrome according to criteria NCEP ATP III		Total
		MS	non MS	
WC > 85 cm	Number	65	113	178
	%	36,5	63,5	100
WC ≤ 85 cm	Number	5	44	49
	%	10,2	89,8	100
	Total	70	157	227

OR = 5.062; 95% Confidence Interval = 1.91-13.4; *p*< 0,0001

Number of Patients with Metabolic Syndrome According to Modified Criteria in Men with Waist Circumference ³ 85 cm

Of 178 subjects with waist circumference > 85 cm, two of them did not have oral glucose tolerance test. From 176 subjects with waist circumference > 85 cm who underwent oral glucose tolerance test, we found 117 subjects (66.5%) had at least two other risk factors

or had metabolic syndrome according to modified criteria. (Table 7) Waist circumference > 85 cm identified subjects who fulfilled modified criteria of metabolic syndrome with high sensitivity of 92.1% but relatively low specificity of 39.8%, although it was higher than specificity by NCEP ATP III criteria. Subjects with waist circumference > 85 cm had relative risk 7.7 times higher to have at least two other risk factors or had fulfilled modified criteria for metabolic syndrome compared to those whose waist circumference ≥ 85 cm. (95% CI 3.61-16.57; p<0.0001). (Table 7)

Table 7. Number of Patients with Metabolic Syndrome According to Modified Criteria in Men with Waist Circumference ≥ 85 cm

		Metabolic syndrome (SM) according to modified criteria		Total
		SM	Non SM	
WC > 85 cm	Number	117	59	176
	%	66,5	33,5	100
WC ≤ 85 cm	Number	10	39	49
	%	20,4	79,6	100
	Total	127	98	225*

OR = 7,734; 95% Confidence Interval = 3,61-16,57; *p*< 0,0001
*) 2 subjects did not have oral glucose tolerance test with 75 gram of glucose

DISCUSSION

Since firstly introduced by Reaven in 1988, the term 'syndrome X' has undergone several changes including 'insulin resistance syndrome' and dysmetabolic syndrome'.[6,7] In 1999, WHO used the term 'metabolic syndrome' officially. NCEP ATP III in 2001 simplified metabolic syndrome criteria by using more practical and easier measure of its several components for daily clinical practice.[1] Several studies proved that risk of coronary heart disease (CHD) and metabolic syndrome had increased in impaired glucose tolerance and IPCH.[8,9] This is the reason why we used modified criteria of NCP ATP III in this study using oral glucose tolerance test instead of fasting plasma glucose concentration in order to include patients with impaired fasting glucose tolerance, impaired glucose tolerance and diabetes mellitus.

In this study using modified criteria, metabolic syndrome in subjects who apparently were healthy men was found relatively high (56.4%) compared to NCEP ATP III criteria which could only detect 30.8%. This difference is due to new additional risk factors of CHD: impaired glucose tolerance and asymptomatic diabetes mellitus (isolated post challenge hyperglycemia/IPCH). By using WHO suggestion for central obesity for adult Asian male in subjects with waist circumference ≥ 90 cm, we found the subjects with metabolic syndrome were 79.2%. Although more subjects were found with waist circumference > 85 cm (178 subjects), the prevalence of metabolic syndrome was lower (66.5%), while the study by Lemieux et al using different criteria in Canada had reported almost the same result (80%) in those whose waist circumference > 90 cm.

A study by Lean et al[10] in 5877 male subjects aged between 20-59 years old in Netherlands found that relative risk to have at least one risk factor of CHD was increased when waist circumference increased. Subjects with waist circumference 94-101.9 cm had relative risk of 2.2 times higher than those whose waist circumference < 94 cm (95% CI 1.9-2.5). In subjects whose waist circumference ≥102 cm had relative risk to have at least one risk factors of CHD increased to 4.2 times higher compared to subjects with waist circumference <94 cm (95% CI 3.46-4.9). This study had almost the same result as our study. Subjects whose waist circumference >85 cm had relative risk 7.7 times higher than those whose waist circumference ≤85 cm. Subjects whose waist circumference ≥90 cm had relative risk 11.3 times higher than those whose waist circumference < 85 cm.

CONCLUSION

Waist circumference ≥ 90 cm seems to be effective as a screening test for metabolic syndrome. In this study, waist circumference ≥ 90 cm is found to have high sensitivity and specificity (88.2% and 60.2%) in detecting men with metabolic syndrome.

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