Original Article

Metabolic syndrome and related factors of Thai people on routine health check-up in Her Royal Highness Princess Maha Chakri Sirindhorn Medical Center[@]

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บทคัดย่อ:

ความเป็นมา: เมตาบอลิกซินโดรมเป็นความผิดปกติทางการแพทย์ที่เสี่ยงต่อโรคหัวใจและหลอดเลือด รวมทั้งโรคเบาหวาน การมีพฤติกรรมสุขภาพที่ไม่เหมาะสมทำให้เสี่ยงต่อการเกิดกลุ่มอาการนี้

วัตถุประสงค์: เพื่อหาความสัมพันธ์ระหว่างเมตาบอลิกซินโดรม กับ เพศ กลุ่มอายุ พฤติกรรมเสี่ยงต่อสุขภาพ และเปรียบเทียบระดับความสัมพันธ์กับองค์ประกอบของเมตาบอลิกซินโดรม

วัสดุและวิธีการ: การศึกษาแบบภาคตัดขวาง โดยเก็บข้อมูลจากผู้มารับบริการตรวจสุขภาพประจำปีที่ศูนย์การแพทย์สมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี ตั้งแต่พฤศจิกายน พ.ศ. 2550 ถึง ธันวาคม พ.ศ. 2551 วิเคราะห์สหสัมพันธ์ด้วย Logistic regression แบบสองทางด้วยค่า $p<0.05$

ผลการศึกษา: ผู้มารับบริการ 466 คน เข้าร่วมในการศึกษา พบความชุกของเมตาบอลิกซินโดรมร้อยละ 11 ไม่พบความสัมพันธ์กับเพศและกลุ่มอายุ การออกกำลังกายไม่เพียงพอเป็นพฤติกรรมเดี่ยวที่เป็นปัจจัยเสี่ยงอย่างมีนัยสำคัญทางสถิติ odds ratio 2.6 (95%CI=1.1-5.9) ภาวะ high density lipoprotein (HDL) ที่ต่ำเป็นองค์ประกอบสำคัญที่พบได้บ่อยที่สุดในผู้ที่เป็นเมตาบอลิกซินโดรม odds ratio 30.6 (95%CI=5.9-158.0) ค่า uric acid, serum glutamic oxaloacetic transaminase (SGOT), alkaline phosphatase, และ low density lipoprotein (LDL) ที่ค่อนข้างสูง รวมทั้งการเอกซเรย์ทรวงอกพบหัวใจโตเป็นความผิดปกติที่พบร่วมกับเมตาบอลิกซินโดรม

สรุป: ความชุกของเมตาบอลิกซินโดรม พบร้อยละ 11 และระดับ HDL ต่ำ เป็นปัจจัยเสี่ยงของการเกิดเมตาบอลิกซินโดรม

คำสำคัญ: ตรวจสุขภาพ, เมตาบอลิกซินโดรม, ประชากรไทย

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Abstract:

Background: Metabolic syndrome is a combination of medical disorders that increases the risk of developing cardiovascular disease and diabetes. Poor life style increases the risk of metabolic syndrome.

Objective: The objective of this study was to determine the effect of gender, age group, and health risk behaviors on metabolic syndrome and

to compare the level of association of metabolic syndrome with its components.
Materials and methods: A cross-sectional study was conducted on who attended Her Royal Highness (HRH) Princess Maha Chakri Sirindhorn Medical Center for their annual health check-up from November, 2007 to December, 2008. The authors used logistic regression for multivariate analysis and two-tailed p-value of less than 0.05.
Results: 466 patients were conducted into the study. The prevalence of metabolic syndrome was 11%. There were no significant differences in gender and age groups. Inadequate exercise was the only health risk behavior with odds ratio of 2.6 (95%CI=1.1-5.9). Low HDL was a significant predictor of metabolic syndrome with odds ratio of 30.6 (95%CI=5.9-158.0). High serum uric acid, serum glutamic oxaloacetic transaminase (SGOT), alkaline phosphatase, and low density lipoprotein (LDL) were the concomitant abnormal findings of metabolic syndrome and cardiomegaly as revealed by a chest X-ray, was also a concomitant finding.
Conclusion: The prevalence of metabolic syndrome was found 11%. Inadequate exersice and low HDL were risk factors of metabolic syndrome.

Key words: health check-up, metabolic syndrome, Thai people

Introduction

Metabolic syndrome is a combination of medical disorders that increases the risk of developing cardiovascular disease and diabetes[1]. Abdominal obesity and hypertriglyceridemia are predictors of vascular damage.[2] The prevalence increases with age and in the USA is found in up to 25% of the population.[3] It is also a major health problem in Thailand with an overall prevalence of 15% in year 2003 to 2004. In males, the prevalence increases from 9.5% in the age group 20-39 years to 24.7% in the age group above 50 years while in females, the prevalence increases from 7% to 29.5%.[4] There is also a gender difference in coronary artery disease.[5] It is associated with metabolic syndrome but not with body mass index (BMI).[5] A poor life style, such as sleep deprivation,[6] eating unhealthy foods, drinking alcoholic beverages, and smoking,[7] increases the risk of metabolic syndrome.

Metabolic syndrome is recognized by many health-related organizations such as the International Diabetes Federation (IDF),[8] the World Health Organization (WHO, 2000),[9] the National Cholesterol Education Program in Adult Treatment Panel III (NCEP ATP III),[10] etc. The common criteria in all of these organizations include abdominal obesity, high triglyceride and low high density lipoprotein (HDL) cholesterol levels, high blood pressure, and high fasting blood sugar levels. These conditions may combine to indicate a risk of metabolic syndrome in different ways, such as abdominal obesity with two of the other four conditions,[8] high fasting blood sugar with two of the other four conditions,[9] or any three of the five conditions.[10] Gender is also a consideration in Japanese women, for instance, abnormal low density lipoprotein (LDL) cholesterol and high blood pressure correlate to metabolic syndrome, but not in Japanese men.[11] Abdominal obesity correlates to insulin sensitivity in Japanese people.[12] In Thai people, obesity, as classified by body mass index, is a major indication of metabolic syndrome[4]. So there are many conditions which may be correlated to metabolic syndrome, but they have dissimilar intensities of correlation. The present study determines the effect of gender and obesity on metabolic

syndrome as the previous study and determines intensities of correlation between risk factors and metabolic syndrome. So we can emphasize which risk factors should be the first priority prevention of metabolic syndrome in Thai people.

The objective of the present study was to determine the effect of gender, age groups, and health risk behaviors in Thai people on metabolic syndrome, and to compare the level of association of metabolic syndrome with hypertension, triglyceride, HDL cholesterol and fasting blood sugar levels, and obesity.

Materials and methods

Study population

Data were collected for a cross-sectional study from a sample of 466 subjects who went to the Her Royal Highness (HRH) Princess Maha Chakri Sirindhorn Medical Center during the study period for an annual health check-up. The study was approved by the Ethics Committee of the Faculty of Medicine, Srinakharinwirot University.

Study definitions

The definition of metabolic syndrome was adapted from those used by the IDF,[8] WHO[9] and NCEP ATP III[10] and was based on a waist circumference of 90 centimeters in males and 80 centimeters in females and at least 2 signs of abnormal metabolism of:

- Triglyceride level 150 mg/dl or above.[7,9,10]
- HDL cholesterol level up to 40 mg/dl in males and up to 50 mg/dl in females.[8,10]
- Blood pressure of 140/90 mmHg or higher, or the subject was taking regular antihypertensive medication.[9]
- Fasting blood sugar 110 mg/dl or higher.[10]

To measure daytime sleepiness in the study patients, the Epworth sleepiness scale (ESS) was used. The ESS is based on a questionnaire which measures excessive daytime sleepiness (EDS), and can be helpful in diagnosing sleep disorders. It was introduced in 1991 by Dr.Murray Johns of the Epworth Hospital in Melbourne, Australia.[13]

To assess depression in the Thai population, the standard diagnostic screening test is the Health-Related Self-Reported (HRSR) Scale from the Department of Mental Health of the Thai Ministry of Public Health, which examines stress, depressive moods, or other psychological problems and major depression.

Obesity was defined as a body mass index (BMI) of 25 kg/m^2 or higher, including obesity type 1 and obesity type 2.[14]

Health risk behaviors in the study were adapted from the health risk behaviors identified by the Thai Ministry of Public Health, and included smoking cigarettes, sleeping less than 5 hours per day (sleep deprivation),[15] exercise less than 30 minutes per day and less than 3 days per week (inadequate exercise), eating unhealthy foods (high fat, high salt, high sugar, low fiber), more than 2 alcoholic drinks in males and 1 in females per day.

Data collection

Data collected for the study was age, gender, waist circumference, weight, height, underlying diseases, health risk behaviors, and laboratory results including chest X-ray, electrocardiography

(EKG), urine examination, and stool examination. The data were collected from November, 2007 to December, 2008. The subjects were not specifically identified by name.

Statistical analysis

Categorical variables were analyzed using the Chi-square test. For continuous and binary response variables, significant explanatory variables were first identified through bivariate analysis and then logistic regression was used for multivariate analysis. A two-tailed p-value of less than 0.05 was considered significant.

Results

There were 466 patients (57.1% females and 42.9% males), with the highest age frequency in the 40-49 years group. The most common underlying diseases was allergy (Table 1).

In this study, 13.9% of the males and 8.8% of the females were diagnosed with metabolic syndrome. The difference was not statistically significant. The overall prevalence was 11%. The 40-49 years age group had the highest prevalence of metabolic syndrome, and the under-30 years group the lowest prevalence (Table 2).

The ranking of odds ratios related to indicators of possible metabolic syndrome from the highest to the lowest was low HDL, hypertension, high triglycerides, obesity, and high fasting blood sugar. Inadequate exercise was the only health risk behavior significantly associated with metabolic syndrome. Persons with inadequate exercise had 2.6 times higher risk of metabolic syndrome

Table 1 Characteristics of the subjects

Characteristic	Number (%)	Characteristic	Number (%)
Gender:			
Male	200 (42.9)	Underlying Disease: None	278 (59.7)
Female	266 (57.1)	Allergy	68 (14.6)
Age: years			
<30	37 (7.9)	HT/DM/Dyslipid	63 (13.5)
30-39	108 (23.2)	Allergy+	6 (1.3)
40-49	176 (37.8)	Goiter	9 (1.9)
50-59	131 (28.1)	Thalassemia	5 (1.1)
≥60	14 (3)	Other	37 (7.9)

"HT/DM/Dyslipid" means hypertension or diabetic mellitus or dyslipidemia.

"Allergy+" means allergy combined with hypertension or diabetic mellitus or dyslipidemia.

"Other" included such conditions as hepatitis carrier, herniated disc, valvular heart disease, hemorrhoids, etc.

Table 2 Comparing metabolic syndrome in each gender and each age group

	Metabolic Syndrome		P-value
	No (%)	Yes (%)	
Gender:			
Male	155 (86.1)	25 (13.9)	0.098
Female	218 (91.2)	21 (8.8)	
Age: years			
<30	30 (96.8)	1 (3.2)	0.313
30-39	85 (91.4)	8 (8.6)	
40-49	141 (85.4)	24 (14.6)	
50-59	106 (89.8)	12 (10.2)	
≥60	11 (91.7)	1 (8.3)	
Total	**373 (89)**	**46 (11)**	

than persons who had adequate exercise (Table 3).

Persons who had metabolic syndrome an average had higher uric acid, Serum Glutamic Oxaloacetic Transaminase (SGOT), alkaline phosphatase, and LDL than persons who had no metabolic syndrome but BUN, creatinine, Serum Glutamic Pyruvic Transaminase (SGPT), and cholesterol levels were not significantly different (Table 4).

Subjects with cardiomegaly had more than 3 times higher prevalence of metabolic syndrome than subjects without. There were no significant differences in depression, excessive daytime sleepiness, and abnormal EKG (Table 5).

Table 3 Risk factors for metabolic syndrome by logistic regression

Factor		Odds ratio	P-value	95% Confidence interval
Obesity	No	1	Reference group	
	Yes	6.34	0.003	1.90-21.12
Triglycerides	<150 mg/dl	1	Reference group	
	≥150 mg/dl	19.17	<0.001	5.76-63.74
HDL	Normal	1	Reference group	
	Low	30.64	<0.001	5.94-157.99
FBS	<110 mg/dl	1	Reference group	
	≥110 mg/dl	3.76	0.046	1.02-13.80
Hypertension	No	1	Reference group	
	Yes	22.27	0.008	2.22-223.10
Excessive alcohol drinking	No	1	Reference group	
	Yes	1.81	0.12	0.86-3.82
Inadequate exercise	No	1	Reference group	
	Yes	2.59	0.02	1.14-5.87

HDL, high density lipoproteins; normal levels are greater than 40 mg/dl in males and 50 mg/dl in female.;
FBS means fasting blood sugar.
Hypertension was defined as blood pressure >140/90 mmHg, or the subject was using medically-prescribed anti-hypertensive medication.

Table 4 Bivariate analysis between metabolic syndrome and other blood chemistries

Blood chemistries		Metabolic syndrome (mean)		N	Standard error	P-value*
		No	Yes			
Kidney	BUN (mg/dl)	12.19	12.11	365	0.60	0.8967
	Creatinine (mg/dl)	0.89	0.93	364	0.03	0.1328
	Uric acid (mg/dl)	5.12	6.10	350	0.26	0.0004
Liver	SGOT (U/L)	44.40	73.07	357	13.68	0.0419
	SGPT (U/L)	23.35	38.02	357	9.94	0.1471
	Alk. Phos. (U/L)	71.46	82.75	356	3.74	0.0039
Lipids	LDL (mg/dl)	135.70	124.76	251	5.33	0.0453
	Cholesterol (mg/dl)	216.31	221.69	368	7.09	0.4510

*P-value from t test with unequal variance.

Alk. Phos. Alkaline Phosphatase.

Table 5 Bivariate analysis comparing metabolic syndrome with depression, EDS, EKG, and chest X-ray

Effect		Metabolic syndrome		Prevalence rate ratio	95%Confidence interval
		No (%)	Yes (%)		
Depression	No	296 (95.5)	37 (92.5)	1.59	0.54-4.63
	Yes	14 (4.5)	3 (7.5)		
EDS	No	116 (59.8)	16 (57.1)	1.10	0.55-2.21
	Yes	78 (40.2)	12 (42.9)		
EKG	Normal	146 (91.3)	22 (81.5)	2.01	0.86-4.69
	Abnormal	14 (8.7)	5 (18.5)		
Chest X-ray	Normal heart	352 (95.9)	39 (84.8)	3.19	1.62-6.30
	Cardiomegaly	15 (4.1)	7 (15.2)		

EDS, excessive daytime sleepiness, as classified by the Epworth sleepiness scale

Discussion

The overall prevalence of metabolic syndrome was 11%. There was no significant gender or age group difference (Table 2). These findings were different from the study of Ford, et al.[3] in 2002 and Pongchaiyakul, et al.[4] perhaps due to different locations, life styles, and age groups of the study populations.[3,4] In our study, the 40-49 years age group had the highest prevalence of metabolic syndrome, which was different from an earlier study at Khon Kaen, Thailand, in which the >50 years age group had the highest percentage[4]. This finding may be related to a 'cohort effect', with the 40-49 year age group cohort having a higher incidence of metabolic syndrome than older age groups, so further studies should consider following birth cohorts and demographic structure of Khon Kaen and Nakhon Nayok may be different. Metabolic syndrome had the highest association with low HDL, followed by hypertension, high triglycerides, obesity, and high fasting blood sugar (Table 3). A low HDL level was a major component of metabolic syndrome. Other metabolic indicators associated with metabolic syndrome in our study were significantly high levels of uric acid, SGOT, alkaline phosphatase, and LDL (Table 4). The study of Lohsoonthorn, et al.[16] also found that a high level of serum uric acid was positively associated with metabolic syndrome in Thai people.[16] One study hypothesized that insulin resistance in metabolic syndrome played a fundamental role in the pathogenesis of non-alcoholic fatty liver disease (NAFLD) and that increasing levels of Very Low Density Lipoprotein (VLDL) were associated with higher levels of liver enzymes (although SGPT may be found in lower levels in cases of fibrosis but it should be confirmed by ultrasonography) and LDL higher than in case of non metabolic syndrome.[17] High serum uric acid, SGOT, alkaline phosphatase, and LDL may indicate a future risk of cardiovascular disease.

Metabolic syndrome patients had 3.19 times more cardiomegaly than persons who had no metabolic syndrome, but the condition was not associated with depression, excessive daytime sleepiness, or abnormal EKG (Table 5). The study of Legedz et al.[18] found that insulin resistance and elevated plasma triglyceride levels may contribute to cardiac hypertrophy and arterial stiffening independently of hemodynamic and hormonal factors. The reason our abnormal EKG findings were not associated with metabolic syndrome may have been due to our low sample size (the amount of people who came to health check-up, checked EKG very low). Patients who had metabolic syndrome frequently had depression. The pathophysiology for the association was described by Chrousos[19] who suggested that the hypothalamic pituitary adrenal axis (HPA axis) produces hypersecretions of corticotrophin-releasing hormone, adrenocorticotropic hormone, and cortisol, which then promote deposition of visceral adipose tissue which in turn secretes inflammatory cytokines and tumor necrosis factors. These cytokines and tumor necrosis factors have been implicated in insulin resistance, which has been suggested as the key factor in the metabolic abnormalities of metabolic syndrome[20] and excessive daytime sleepiness.[21] In the present study,

these factors were not associated with metabolic syndrome, but we believe that was due to information bias and a low power of differentiation in our analytic methods. We should extend data collection time and give more information to patients before they are asked to fill in our questionnaires.

The only health risk behavior which was found to be significantly associated with metabolic syndrome in our study was inadequate exercise (Table 3). Subjects who did not get adequate exercise were at 2.59 times the risk to have metabolic syndrome than subjects who got adequate exercise, however the 95% CI was closed to unity (Table 3). The study of Reseland et al.[22] found that lifestyle changes resulting in decreased intake of dietary fat and increased exercise reduced plasma leptin concentrations which lead to the reduction of body fat. Exercise also increases HDL levels which can decrease cardiovascular risk.[23] The present study found that only inadequate exercise increased the risk of metabolic syndrome, but other studies have found that smoking,[7] sleep deprivation,[6] and excessive alcohol drinking[24,25] were also risk factors for metabolic syndrome. Our results may have been affected by information bias, in that the questionnaires we used had just a few details so the subjects may have been confused and gave incomplete or incorrect information. We should give more details of our questionnaires and should explain the questionnaires before we collected data.

Conclusion

In conclusion, the prevalence of metabolic syndrome found in this study of Thai patients was 11%. There were no effects of gender or age group on metabolic syndrome. Inadequate exercise was the only health risk behavior and low HDL was a major component of metabolic syndrome. Uric acid, SGOT, alkaline phosphatase, and LDL were the abnormal metabolic parameters associated with metabolic syndrome, and cardiomegaly on chest X-rays was also an associated finding.

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