Prevalence of Metabolic Syndrome among Professional and Office Workers in Bangkok, Thailand

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Objective: *To estimate the prevalence of metabolic syndrome (MetS) among Thai professional and office workers and to compare the prevalence with other populations.*
Material and Method: *The authors conducted a cross-sectional study of 1,339 professional and office workers (535 men and 804 women) who participated in the annual health examinations at the Mobile Health Checkup Unit of King Chulalongkorn Memorial Hospital in Bangkok, Thailand during the period of August through December 2001. MetS was defined using the modified NCEP ATP III criteria. Chi-square tests were used to evaluate differences in distribution of covariates for affected and unaffected patients.*
Results: *The prevalence of MetS among Thai professional and office workers was 15.2% and approximately 3 times more common among men than women (25.8% vs. 8.2%). Men and women with MetS were older ($p < 0.05$) and were less well-educated ($p < 0.05$) than those without MetS. The three most common metabolic abnormalities in men were high blood pressure (45.0%), BMI $\geq$ 25 kg/m^2 (40.7%) and hypertriglyceridemia (38.7%). Among women, high blood pressure (22.8%), BMI $\geq$ 25 kg/m^2 (20.9%) and low HDL-Cholesterol (18.4%) were the most common metabolic abnormalities noted.*
Conclusion: *The prevalence of MetS in this cohort of Thai professional and office workers was as high as those observed in developed countries. These findings emphasize the urgent need to develop strategies for the detection, treatment, and prevention of MetS. Such efforts will contribute to attenuating the incidence of cardiovascular disease and diabetes.*

Keywords: *Metabolic syndrome, Prevalence, Thailand*

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Metabolic syndrome (MetS), a clustering of metabolic abnormalities, has been found to convey a significant risk for future atherothrombotic cardiovascular events. MetS includes high blood pressure, elevated triglycerides, low high-density lipoprotein (HDL) concentration, impaired fasting glucose, and excess abdominal fat. Multiple diagnostic criteria have been proposed for detecting MetS[1-5]. The prevalence of MetS varies according to definitions used and populations studied[6]. For instance, the prevalence of MetS among U.S. adults, sampled for the Third National Health and Nutrition Examination Survey, varied from 16% among African-American men to 37% among Hispanic women[7]. A comparison of the prevalence of the MetS using two proposed definitions among American adults ($\geq$ 20 years of age) indicated that age-adjusted MetS prevalence estimates were 24% using the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) criteria versus 25% using the World Health Organization (WHO) criteria[8].

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Despite differences in overall MetS prevalence estimates, published reports consistently indicate that MetS increases with age[7,9,10] and increasing body weight[11]. MetS has emerged as an important clinical and public health problem because it is strongly predictive of diabetes and cardiovascular disease risk[12-15]. Public health authorities predict that MetS will soon overtake cigarette smoking as the primary risk factor for cardiovascular disease among Americans[11,16]. Thailand, moving towards changes in lifestyle and behaviors similar to that of Western cultures, is likely to face increasing challenges of preventing chronic diseases including cardiovascular disease and diabetes. Little information exists on the prevalence of the MetS among Thais. Such data are important for planning national chronic disease treatment and prevention programs. The authors therefore conducted the present study to estimate the prevalence of MetS among Thai professional and office workers. The authors also compared the prevalence of MetS defined using two criteria for central obesity (BMI $\geq$ 25 kg/m^2 and BMI $\geq$ 23 kg/m^2), and the authors compared the prevalence of MetS among Thais with estimates reported from other populations.

Material and Methods

Study population and Data collection

The authors conducted a cross-sectional study of 1,339 professional and office workers (535 men and 804 women) who participated in annual health examinations at the Mobile Health Checkup Unit of King Chulalongkorn Memorial Hospital in Bangkok, Thailand during the period of August through December 2001. During routine clinic visits, participants were asked to provide information about their age, marital status, occupation, educational attainment, medical history, smoking status, alcohol consumption habits, and participation in regular physical exercise. Participants underwent routine physical examinations that included a collection of venous blood samples after an overnight fast. Measurements of height, weight, and resting blood pressure were taken during exams. Standing height was measured to the nearest 0.5 centimeter without shoes. Weight was determined without shoes and with participants lightly clothed. Weight was measured using an automatic electronic scale (Seca, Inc., Hamburg, Germany) to the nearest 100 grams. Blood pressure, measured using an automatic sphygmomanometer (UDEX-IIα, UEDA, Corp., Tokyo, Japan), was taken in the seated position after each subject rested for at least 5 minutes.

Laboratory analyses

Participants provided an overnight fasting venous blood sample. Serum samples were used to determine participants' lipid profiles. Serum triglycerides (TG) concentration was determined by standardized enzymatic procedures using glycerol phosphate oxidase assay. High-density lipoprotein-cholesterol (HDL-C) was measured by a chemical precipitation technique using dextran sulfate. Plasma samples were used to determine participants' fasting plasma glucose (FPG) using the hexokinase method. All laboratory assays were completed without knowledge of participants' medical history. Lipid, lipoprotein, and FPG concentrations were reported as mg/dL.

All participants provided informed consent and the research protocol was reviewed and approved by the Ethical Committee of the Faculty of Medicine, Chulalongkorn University, and the Division of Human Subjects Research, University of Washington.

Analytical variable specification

MetS was defined using a modified version of the NCEP-ATP III criteria[1]. Briefly, four of the five MetS components were defined using the following NCEP-ATP III categorizations: 1) raised blood pressure systolic BP $\geq$ 130 or diastolic BP $\geq$ 85 mmHg or previously treated hypertension; 2) raise triglyceride $\geq$ 150 mg/dL; 3) low high-density lipoprotein-cholesterol (HDL-C) < 40 mg/dL in men and < 50 mg/dL in women; 4) raise fasting plasma glucose $\geq$ 110 mg/dL or previously diagnosed type 2 diabetes. The fifth component was defined based on body mass index (BMI). Measures of participants' waist and hip circumferences are not routinely measured in the present study setting, thus the authors were not able to categorize subjects according to measures of central adiposity. Subjects with a BMI $\geq$ 25 kg/m^2 were classified as having a high central obesity in the present study population[17]. Consistent with the ATP III diagnostic criteria for MetS, participants with three of any of the five components were classified as having MetS. To compare the prevalence of MetS with modified ATP III-BMI $\geq$ 25 criteria, the authors also classified subjects with a BMI $\geq$ 23 kg/m^2 as having high central obesity based on Western Pacific Regional Office of WHO (WPRO) criteria[18].

Statistical analyses

The authors first explored frequency distributions of socio-demographic, behavioral characteristics and medical histories. For categorical variables, the authors used Chi-square tests to evaluate differences

Table 1. Prevalence of one or more components of the metabolic syndrome among professional and office workers in Bangkok, Thailand

Number of metabolic abnormalities	Men (n = 535)				Women (n = 804)				Total (n = 1,339)			
	BMI ≥ 23		BMI ≥ 25		BMI ≥ 23		BMI ≥ 25		BMI ≥ 23		BMI ≥ 25	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
None	117	21.9	164	30.7	346	43.0	424	52.7	463	34.6	588	43.9
≥ 1	418	78.1	371	69.3	458	57.0	380	47.3	876	65.4	751	56.1
≥ 2	268	50.1	232	43.4	228	28.4	173	21.5	496	37.0	405	30.2
≥ 3*	160	29.9	138	25.8	93	11.6	66	8.2	253	18.9	204	15.2
≥ 4	52	9.7	46	8.6	25	3.1	21	2.6	77	5.8	67	5.0
5	9	1.7	9	1.7	4	0.5	4	0.5	13	1.0	13	1.0

*According to criteria in the National Cholesterol Education Program Expert Panel Adult Treatment Panel III[1]; individuals with three or more metabolic abnormalities were classified as having metabolic syndrome

in distribution of covariates for affected and unaffected patients. All analyses were completed separately for male and female patients. Statistical analyses were performed using SPSS (version 13.0, SPSS Inc. Chicago, IL, USA) software. All reported p-values were two tailed, and confidence intervals were calculated at the 95% level. A p-value of less than 0.05 was considered significant.

Results

Overall, the prevalence of MetS among Thai workers in the present study was 15.2%. Of note, MetS was more common among men (25.8%) than among women (8.2%). The overall prevalence of MetS was 18.9% when central obesity was defined using the more stringent criteria for central obesity (BMI ≥ 23 kg/m^2). The prevalence of MetS was 2.6 times higher in men than women (29.9% vs. 11.6%) when the more stringent criteria was used to defined central obesity (Table 1). Among men, the age specific prevalence of MetS was increased with age (6.8%, 19.3%, 30.7% and 35.1% for age-group < 30, 30-39, 40-49, and 50 years and over, respectively). Among women, there was also a similar trend for age specific prevalence of MetS (0.0%, 4.0%, 7.4% and 17.5% for age-group < 30, 30-39, 40-49, and 50 years and over, respectively). The elder group aged 50 years and over of both genders had the highest age specific prevalence of MetS (Fig. 1).

The prevalence of each component of MetS is summarized in Fig. 2. The three most common metabolic abnormalities in men were high blood pressure (45.0%), BMI ≥ 25 kg/m^2 (40.7%) and hypertriglyceridemia (38.7%). Among women, high blood pressure

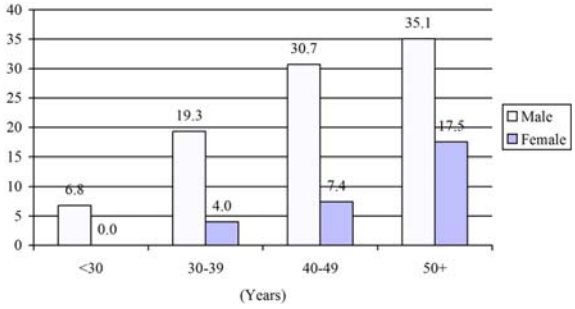

Fig. 1 Age-sex specific prevalence of metabolic syndrome among professional and office workers in Bangkok, Thailand

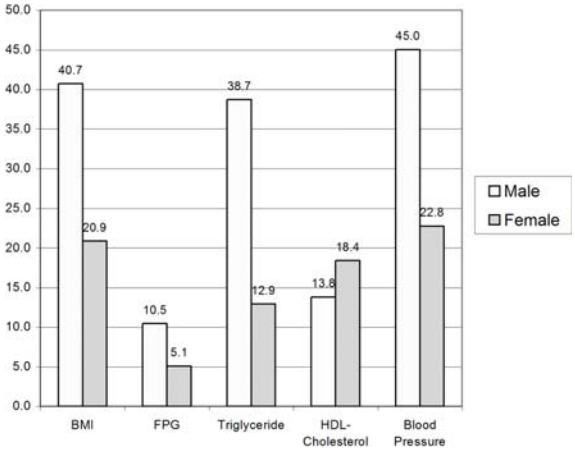

Fig. 2 Prevalence of each component of metabolic syndrome by Gender among Professional and Office Workers in Bangkok, Thailand

(22.8%), BMI ≥ 25 kg/m^2 (20.9%) and low HDL-Cholesterol (18.4%) were the most common metabolic abnormalities noted. As shown in Table 2, both men and women with MetS in comparison to those without the syndrome were older and had lower educational attainment ($p < 0.05$). Other factors including habitual exercise, past alcohol consumption, and cigarettes smoking were not statistically significantly associated with MetS.

Discussion

The prevalence of MetS is age-dependent. In the present study, the prevalence of MetS is 6.8% among men and absent in women < 30 years of age. Of note, MetS prevalence increases to 35.1% for men aged 50 years and over and 17.5% for women in the same age group. Similarly, among US, Korean, Taiwanese, Indian, and Mexican populations the prevalence of MetS is highly age-dependent[7,9,10,19,20]. The prevalence of MetS as defined by ATP III-BMI ≥ 25.0 in this professional and office workers was markedly higher in men than in women (25.8% vs. 8.2%). This marked difference was probably due to the fact that there were three high proportions of metabolic abnormalities among men. They were high blood pressure (45.0%), BMI ≥ 25 kg/m^2 (40.7%), and hypertriglyceridemia

Table 2. Characteristics of study population according to metabolic syndrome status among professional and office workers in Bangkok, Thailand

Characteristics	Metabolic syndrome (Men)					Metabolic syndrome (Women)				
	No (n = 397)		Yes (n = 138)		*p*-value	No (n = 738)		Yes (n = 66)		*p*-value
	n	%	n	%		n	%	n	%	
Age (Years)					<0.001					<0.001
< 30	55	13.9	4	2.9		74	10.0	0	0.0	
30-39	121	30.5	29	21.0		194	26.3	8	12.1	
40-49	147	37.0	65	47.1		314	42.5	25	37.9	
≥ 50	74	18.6	40	29.0		156	21.1	33	50.0	
Education					0.006					<0.001
< Bachelor degree	135	34.0	61	44.2		146	19.8	27	40.9	
Bachelor degree	206	51.9	48	34.8		471	63.8	28	42.4	
> Bachelor degree	49	12.3	22	15.9		117	15.9	10	15.2	
Missing	7	1.8	7	5.1		4	0.5	1	1.5	
Smoking status					0.449					0.553
Never smoker	310	78.1	104	75.4		725	98.2	64	97.0	
Ever smoker	85	21.4	34	24.6		6	0.8	1	1.5	
Missing	2	0.5	0	0.0		7	0.9	1	1.5	
Drinking status					0.487					0.223
Never drinker	160	40.3	60	43.5		678	91.9	62	93.9	
Ever drinker	233	58.7	76	55.1		52	7.0	2	3.0	
Missing	4	1.0	2	1.4		8	1.1	2	3.0	
Exercise					0.477					0.703
Yes	211	53.1	78	56.5		284	38.5	24	36.4	
No	181	45.6	58	42.0		449	60.8	42	63.6	
Missing	5	1.3	2	1.4		5	0.7	0	0.0	
Previously diagnosed diabetes mellitus					0.006					<0.001
No	392	98.7	130	94.2		730	98.9	58	87.9	
Yes	5	1.3	8	5.8		8	1.1	8	12.1	
Previously diagnosed hypertension					<0.001					<0.001
No	378	95.2	102	73.9		699	94.7	45	68.2	
Yes	19	4.8	36	26.1		39	5.3	21	31.8	
Previously diagnosed dyslipidemia					0.014					<0.001
No	336	84.6	104	75.4		583	79.0	37	56.1	
Yes	61	15.4	34	24.6		155	21.0	29	43.9	

(38.7%). Moreover, the authors used the same BMI cutoff point. In women, when the authors used more stringent criteria for central obesity (BMI ≥ 23.0), the prevalence of MetS increased 41.5% (from 8.2% to 11.6%). The criteria for central obesity for women should be lower than men (i.e., BMI ≥ 23.0 for women and BMI ≥ 25.0 for men) as those of waist circumference, which was adjusted for an Asian population (80 cm for women and 90 cm for men)[21].

The prevalence of MetS was widely variable for both men and women across various populations (Table 3). A reviews of studies of adults (≥ 20 years of age), indicated that the prevalence of MetS varied from 5.2% (Korea) to 42.0% (Iran) among men; and from 8.1% (Taiwan) to 41.9% (Saudi Arabia) among women. Use of the NCEP-ATPIII MetS diagnostic criteria with the Asian-Pacific waist circumference criteria; ≥ 90 cm in men and ≥ 80 cm in women, resulted in increased prevalence estimates among the Taiwan population (10.6% to 15.5% in men; and 8.1% to 10.5% in women). Among three studies with ATP III-BMI ≥ 25 for MetS, the Thai population had higher MetS prevalence (25.8%) more than those of Japanese (13.3%) and Chinese (9.8%) male populations, while in the female population, Thai population had lower MetS prevalence than those of Japanese and Chinese populations (8.2% vs. 11.5% and 17.8%)[17,22]. When comparing the present study in Bangkok with a northeast rural Thai population in Khon Kaen, the prevalence of metabolic syndrome among women was higher in Khon Kaen (14.6%) than in Bangkok (8.2%) while among men it was lower in Khon Kaen (15.3%) than in Bangkok (25.8%). However, the criteria for central obesity were slightly different (BMI ≥ 27 for Khon Kaen and BMI ≥ 25 for Bangkok)[23]. Another study in rural Thai population at Chacheongsao province, southeast coastal region of Thailand, the prevalence of MetS with NCEP ATP III was 10.6% among men and 21.2% among women, while using modified Asian criteria, the prevalence of MetS increases to 12.3% for men and 30.8% for women[24]. Despite attempts to reach a consensus on the definition of MetS, varying definitions continue to complicate the comparisons of MetS across populations.

MetS is associated with an increased risk of diabetes and cardiovascular disease morbidity and mortality, which contribute to enormous economic burdens worldwide[14,15]. Men with four or five components

Table 3. Prevalence of metabolic syndrome (using NCEP-ATP III criteria) in men and women as compared with other populations

Country	Year	Age group	Men prevalence %	Women prevalence %	References
1. Thailand	2001	20-60	25.8[a]	8.2[a]	Present study
Thailand	2003-2004	20-90	15.3[c]	14.6[c]	Pongchaiyakul C[23]
Thailand	2004	≥ 35	10.6	21.2	Boonyavarakul A[24]
Thailand	2004	≥ 35	12.3[b]	30.8[b)]	Boonyavarakul A[24]
2. Taiwan	2000-2001	≥ 20	10.6 (15.5)[b]	8.1 (10.5)[b]	Chuang SY et al[19]
	2004	18-84	30.0[b]	22.9[b]	Lin CH[26]
3. Korea	2001	20-82	5.2 (9.8)[b]	9.0 (12.4)[b]	Lee WY et al[27]
4. China	2000-2001	35-74	9.8[a]	17.8[a]	Gu D et al[22]
5. Japan	1999-2002	30-60	13.3[a]	11.5[a]	Shiwaku K et al[17]
6. India	2003	> 20	22.9	39.9	Gupta R et al[20]
7. Saudi Arabia	1995	30-70	40.9	41.9	Al-Nozha et al[28]
8. Iran	1999-2001	> 20	42.0	24.0	Azizi F et al[29]
	2000	10-19	10.3	9.9	Esmaillzadeh A et al[30]
9. Oman	2001	≥ 20	19.5	23.0	AI-Lawati JA et al[31]
10. Ireland	2003	50-69	21.8	21.5	Villegas R et al[32]
11. Greek	2001-2002	> 18	25.2	14.6	PanagiotakosDB et al[33]
12. Turkey	2000	> 31	27.0	38.6	Onat A et al[24]
13. Mexico	2000	20-69	28.5	25.2	Carlos A et al[9]
14. USA	1988-1994	≥ 20	24.0	23.4	Ford ES et al[7]

[a] Modified ATP III-BMI ≥ 25 definition

[b] ATP III with Asia-Pacific criteria for waist circumference: ≥ 90 cm in men and ≥ 80 cm in women

[c] Modified ATP III with BMI ≥ 27 for men and BMI ≥ 25 for women

of the MetS experienced a 3.7-fold increased risk for coronary heart disease and a 24.5-fold increased risk for diabetes compare with men with none of those abnormalities (both $p < 0.0001$)[25]. On the basis of these and other similar findings, patients should be encouraged to assume a physically active lifestyle, to maintain their adult weight, and to follow current dietary guidelines as a means to lower their risk for chronic diseases[11].

Several limitations in the present study should be noted. First, misclassification of MetS status may have occurred in the present study because the authors did not have direct measurements of waist circumference and thus had to use BMI as a proxy measure of central adiposity. Second, the present study population included individuals who received annual health examinations. Some characteristics of the present study population may be substantially different from other populations that do not participate in annual health exams. Consequently, generalizing of the present study results may be limited in that they do not reflect the general Thai population. Third, the authors were not able to thoroughly evaluate MetS in relation to precise details concerning type, frequency, and duration of smoking, alcohol consumption, and physical activity. All of which are known to be associated with MetS components.

In conclusion, the prevalence of MetS varies across studied populations and according to the diagnostic criteria used across studies. The prevalence of MetS among Thai professional and office workers was 15.2% with ATP III-BMI $\geq$ 25 criteria and increased to 18.9% with ATP III-BMI $\geq$ 23 criteria. These prevalence estimates are as high as those observed in some developed countries. These findings emphasize the urgent need to develop intervention strategies for the detection, treatment, and prevention of the MetS. These strategies may help to attenuate the incidence and morbidity associated with cardiovascular disease and diabetes in the Thai population.

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ความชุกของกลุ่มอาการเมตาบอลิคในนักวิชาชีพและพนักงาน ในกรุงเทพมหานคร ประเทศไทย

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***วัตถุประสงค์**: เพื่อศึกษาความชุกของกลุ่มอาการเมตาบอลิคในนักวิชาชีพและพนักงานในกรุงเทพมหานคร และเปรียบเทียบความชุกนี้กับประชากรอื่น*

***วัสดุและวิธีการ**: การศึกษาระยะสั้นในกลุ่มนักวิชาชีพและพนักงานในกรุงเทพมหานคร จำนวน 1339 คน (ชาย 535 คน หญิง 804 คน) ที่มารับการตรวจสุขภาพประจำปี จากหน่วยบริการตรวจสุขภาพนอกสถานที่ของโรงพยาบาลจุฬาลงกรณ์ ระหว่างเดือนสิงหาคม ถึง ธันวาคม พ.ศ. 2544 นิยามของกลุ่มอาการเมตาบอลิคได้ใช้เกณฑ์ดัดแปลงของ NCEP ATP III เปรียบเทียบความแตกต่างของการกระจายของตัวแปรต่างๆ ในกลุ่มที่มีและไม่มีอาการเมตาบอลิค โดยใช้การทดสอบไคสแควร์*

***ผลการศึกษา**: ความชุกของกลุ่มอาการเมตาบอลิคในกลุ่มนักวิชาชีพและพนักงาน พบร้อยละ 15.2 เพศชาย พบมากกว่าเพศหญิงประมาณ 3 เท่า (ร้อยละ25.8 เทียบกับ 8.2) ชายและหญิง ที่มีกลุ่มอาการเมตาบอลิคมีอายุมาก ($p < 0.05$) และมีการศึกษาน้อยกว่า ($p < 0.05$) กลุ่มที่ไม่มีอาการเมตาบอลิค องค์ประกอบกลุ่มอาการเมตาบอลิคที่พบบ่อยสามอันดับแรกในเพศชายได้แก่ความดันโลหิตสูง ร้อยละ 45.0 ดัชนีมวลกาย $\geq$ 25 kg/m^2 ร้อยละ 40.7 และระดับไตรกลีเซอร์ไรด์ในเลือดสูง ร้อยละ 38.7 ในเพศหญิงสามอันดับแรกที่พบบ่อยได้แก่ ความดันโลหิตสูง ร้อยละ 22.8 ดัชนีมวลกาย $\geq$ 25 kg/m^2 ร้อยละ 20.9 และ ไขมันคอเลสเตอรอลชนิดดีต่ำ ร้อยละ 18.4*

***สรุป**: ความชุกของกลุ่มอาการเมตาบอลิคในกลุ่มนักวิชาชีพ และพนักงานของไทยพบสูงมากเหมือนประเทศที่พัฒนาแล้ว สิ่งที่พบนี้เน้นถึงความจำเป็นอย่างรีบด่วน ในการพัฒนากลวิธีในการค้นหารักษา และป้องกันกลุ่มอาการเมตาบอลิค ผลการดำเนินการนี้จะนำไปสู่การลดอุบัติการณ์ ของโรคหัวใจหลอดเลือด และโรคเบาหวาน*