Trends of Metabolic Syndrome Components in Personnel at the Rajavithi Hospital

Charuwan Manmee PhD*,
Ploypassorn Ainwan BBA*, Kanya Janpol MSc*

** Division of Medical Research, Department of Research and Technology Assessment, Rajavithi Hospital, Bangkok, Thailand*

Objective: *Metabolic syndrome (MetS) is a combination of medical disorders which increases the risk of developing diabetes. Studies have shown variable prevalence of this syndrome, but being elderly has often been found to increase the likelihood of developing Mets. This study aims to determine trends in Mets components among Rajavithi Hospital personnel.*
Material and Method: *A cross-sectional study was carried out from 2009 to 2011. Participants were aged 35 years or more, and the numbers of participants were 504, 1,029 and 1,057 in 2009, 2010 and 2011, respectively. Using medical records after an annual check-up, MetS was defined in accordance with the updated National Cholesterol Educational Program Adult Treatment Panel III (NCEP-ATP III) guideline. Binary logistic regression was used to assess the factors associated with Mets.*
Results: *Most participants were female, and the mean ages were 45.8±7.6, 45.6±7.9 and 46.1±7.1 years in 2009, 2010 and 2011, respectively. In each of the three years, mean age, BMI, waist circumference, triglycerides, glucose and uric acid were all significantly higher in individuals who had Mets. The prevalence of Mets in 2009, 2010 and 2011 was 7.1%, 5.9% and 4.6%, respectively. Hypertension was the most common abnormal metabolic risk factor in both sexes. The most frequent cluster of MetS components was a combination of hypertension, hypertriglyceridemia and glucose in males, but hypertension, abdominal obesity, and high triglyceride levels in females. The prevalence of MetS was associated with advancing age, male gender and individuals who worked in administration.*
Conclusion: *The prevalence of Mets was low and decreased slightly each year. Associated risk factors of Mets were increasing age, male gender and working in administration. Some components of MetS, especially waist circumference, blood pressure, triglyceride levels and glucose, are risk factors of metabolic syndrome and should be avoided in order to decrease its prevalence.*

Keywords: *Metabolic syndrome, NCEP/ATP III, Health personnel*

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Metabolic Syndrome (MetS) has been receiving increasing attention globally because of its association with elevated risk of type 2 diabetes, atherosclerosis, and mortality[1-3]. The National Cholesterol Education Program's Adult Treatment Panel III (NCEP/ATP III) identified MetS as a risk factor for developing cardiovascular disease (CVD)[4]. In July 2004, the National Cholesterol Education Program (NCEP) coordinating committee issued an update to the third Adult Treatment Panel (ATP III) guidelines on the detection, evaluation, and treatment of high blood cholesterol in adults. This updated NCEP ATP-III now includes waist circumference, triglycerides, HDL cholesterol, blood pressure and fasting glucose[4,5]. The prevalence of MetS is variable, and it is more common among females than males[6-8]. However, in an age-adjusted study of the prevalence of metabolic syndrome in the United States, the National Health and Nutrition Examination Survey (NHANES) 2005 to 2010 noted that a higher prevalence of MetS was observed in males[9].

The National Health and Nutrition Examination Survey (NHANES) 2003-2006, found that abdominal obesity (53%), hypertension (40%), and hyperglycemia (39%) were the most frequently occurring risk factors for Mets. When stratified by sex, males had a higher age-adjusted prevalence of hypertriglyceridemia, hypertension, and hyperglycemia than females, but females had a higher age-adjusted prevalence of abdominal obesity and more pronounced low HDL cholesterol than males[10].

Correspondence to:
Manmee C, Division of Medical Research, Department of Research and Technology Assessment, 2 Phyathai Road, Rajathewi, Bangkok 10400, Thailand.
Phone: +66-2-3548108 ext. 2803, Fax: +66-2-3545477
E-mail: charuwan_manmee@yahoo.com

Data from NHANES 1999-2000[11] noted that the rate of decline in mean serum total cholesterol concentrations of the adult US population observed from 1960-1962 and 1988-1994 slowed between 1988-1994 and 1999-2000. These declines in the mean serum total cholesterol levels of adults suggest that the drop in total cholesterol levels was due to a fall in low-density lipoprotein (LDL) cholesterol levels. Similarly, representative surveys of the general population were carried out in France during two periods, 1996 to 1997 and 2006 to 2007, and showed favorable downward trends in LDL-cholesterol concentration and dyslipidaemia. The significant decrease in LDL-cholesterol observed among all the subjects, and more particularly among subjects treated with lipid-lowering drugs, can be used as a useful database for physicians to refer to in the management of treatment of French adults[12]. In Thailand, the trend of MetS data varies depending on study subjects and geographical locations. The aim of this study was to assess trends in triglycerides, blood pressure, waist circumference and glucose between 2009 and 2011 in personnel who working at Rajavithi Hospital.

Material and Method

This study aims to determine the prevalence of METs and risk factors associated with it among Rajavithi Hospital personnel. In accordance with the NCEP/ATP III report, participants were defined as having the metabolic syndrome if they met three or more of the following criteria: abdominal obesity (waist circumference >102 cm in men and >88 cm in women); hypertriglyceridemia $\geq$150 mg/dl; low HDL cholesterol (<40 mg/dl in men and <50 mg/dl in women); high blood pressure (>130/85 mmHg); and high fasting glucose (>110 mg/dl). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2). A case record form was used to obtain socio-demographic details such as age, gender, type of work and work departments. Data were collected using medical records and biochemical examination by a field team of nurses or staff trained in research methodology prior to commencement of the study. Data relating to socioeconomic characteristics, Mets components, lipid profile, and routine laboratory tests were recorded for subjects with and without metabolic syndrome. Although this study used secondary data collected during an annual health check-up, the procedure for data collection followed the standard methods; for example, blood pressure measurements were performed using the standard method with cuff size adapted to the subject's arm circumference, and heart rate and blood pressure were measured with the participants in the sitting position by well-trained nurses. Triglyceride concentrations were measured using Enzymatic colorimetric GPO-PAP, and glucose was measured using the standard enzymatic hexokinase method.

All statistical analyses were performed using the software program SPSS for Windows version 17.0 (SPSS Inc., Chicago, Illinois, USA). Baseline characteristics were analyzed using descriptive statistics. Chi-square test was used to compare categorical variables and frequency difference, and student's t-test was used to compare the subjects' physical and metabolic indices. In addition, binary logistic regression analysis was performed to determine the association between MetS and gender, age, clusters of work, and BMI. The prevalence of Mets and its components was calculated for each year. Metabolic syndrome score was calculated as the sum of scores of 3 of 4 components: abdominal obesity, high TG, high blood pressure, and high fasting blood glucose. Subjects received a score of 1 if a component was present and 0 if absent; therefore, the total scores varied from 0 to 4, and were used as dependent variables in regression models. Binary logistic regression was performed to identify factors associated with MetS, and potential confounders including gender, age, and BMI were controlled. The multivariate-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were recorded. A p-value <0.050 was considered to be statistically significant. Ethical clearance was obtained from the Ethics Committee of Rajavithi Hospital.

Results

Most participants were female, and the mean age was 45.8$\pm$7.6, 45.6$\pm$7.9 and 46.1$\pm$7.1 years in 2009, 2010 and 2011, respectively. In all three years, mean age, BMI, waist circumference, triglycerides, glucose and uric acid were significantly higher in those participants who had Mets. Baseline characteristics of the subjects are shown in Table 1.

The prevalence of MetS (based on biological thresholds) decreased from 7.1% (95% CI: 5.1-9.8) in 2009 to 5.9% (95% CI: 4.6-7.6) in 2010 and 4.6% (95% CI: 3.5-6.1) in 2011. Although the prevalence of MetS declined in each year when measured based on clinical targets, there was a divergence in trends for its individual components, mainly high waist circumference, high blood pressure and high triglycerides for the total population and among genders

Table 1. Baseline characteristics of the subjects

Characteristics	2009 (n = 504)			2010 (n = 1,029)			2011 (n = 1,057)		
	Normal (n = 468)	Mets (n = 36)	*p*-value	Normal (n = 968)	Mets (n = 61)	*p*-value	Normal (n = 1,008)	Mets (n = 49)	*p*-value
Age (years)	45.59±7.60	48.72±7.45	0.017	45.30±7.85	49.62±7.49	<0.001	46.00±7.07	48.82±8.15	0.021
Sex (male)	70 (15.0%)	7 (19.4%)	0.471	119 (11.3%)	17 (29.9%)	<0.001	118 (11.7%)	8 (16.3%)	0.330
Clusters			0.085			0.001			0.523
Academic	-	-		223 (24.1%)	17 (27.9%)		276 (27.4%)	10 (20.4%)	
Nurse	313 (66.9%)	19 (52.8%)		529 (55.7%)	21 (34.4%)		581 (57.6%)	30 (61.2%)	
Administration	155 (33.1%)	17 (47.2%)		196 (20.2%)	23 (37.7%)		151 (15.0%)	9 (18.4%)	
BMI (kg/m^2)	23.63±3.70	30.17±4.55	<0.001	24.25±4.00	30.33±4.27	<0.001	24.18±3.90	29.66±6.65	<0.001
Waist circumference (inch)	30.59±3.20	36.36±3.12	<0.001	31.23±3.55	37.39±3.47	<0.001	31.73±3.51	37.97±4.35	<0.001

Values were represented as number (%) and mean ± SD.
Significant at $p<0.050$.

(Table 2). For example, the prevalence of excessive waist circumference increased each year from 11.9% (95% CI: 9.2-15.1 in 2009 to 12.6% (CI: 10.7-14.8) in 2010, and 15.8% (CI: 13.7-18.2) in 2011. The prevalence and trends of the components of MetS over the three-year period are shown in Fig. 1.

Baseline rates of large waist circumference were much higher among females than males in all three years. Estimates of elevated blood pressure for the total population declined over time from 41.3%, to 32.1% and 28.6% in 2009, 2010, and 2011, respectively. However, data pertaining to the use of antihypertensive drugs were not collected in the present study.

We also divided our subjects into 4 categories based on age (35-39, 40-49, 50-59, and ≥60 years), and a comparison of the prevalence rates of MetS in each age group for the three years is shown in Fig. 2. The four components of MetS in the different age groups were also investigated, and the results showed that the prevalence of MetS and each of its individual component increased with advancing age.

Discussion

Many countries face an epidemic of non-transmissible chronic diseases as a result of the increasing prevalence of obesity. The present study showed that the prevalence of MetS declined slightly over the study period when measured on the basis of clinical targets using the biological thresholds outlined in Adult Treatment Panel-III. However, even with this decrease, approximately 5-10% of the adult personnel would be classified as having MetS, when measured for at least 4 of 5 MetS components. Our results show a lower prevalence compared to other studies that used similar ATP III criteria to define MetS and found that approximately 22% of US adults had MetS, with little difference between gender and race/ethnicity[13].

The most common abnormal metabolic risk factor for both genders was hypertension. The most frequent cluster of MetS components included hypertension, hypertriglyceridemia and glucose in males, but hypertension, abdominal obesity, and high TG level in females. This pattern was similar to most population-based studies in Asia[14,15], but slightly different from the western countries where abdominal obesity was the most common risk factor in both sexes[16]. In the present study, MetS components showed divergent trends. We found declines in dyslipidemia, specifically in hypertriglyceridemia, results that align with previous studies[17]. The continued decreasing trend of some marker levels

Table 2. Prevalence of the metabolic syndrome and components in personnel standardized by sex

	2009	2010	2011
Metabolic syndrome			
Total population	7.1% (5.1-9.8)	5.9% (4.6-7.6)	4.6% (3.5-6.1)
Male	9.1% (3.7-17.8)	12.5% (7.5-1.9)	6.3% (2.8-12.1)
Female	6.8% (4.6-9.6)	4.9% (3.6-6.6)	4.4% (3.2-5.9)
Waist circumference			
Total population	11.9% (9.2-15.1)	12.6% (10.7-14.8)	15.8% (13.7-18.2)
Male	9.1% (3.7-17.8)	4.4% (1.6-9.4)	8.7% (4.4-15.1)
Female	12.4% (9.4-15.9)	13.9% (11.7-16.3)	16.8% (14.4-19.4)
Blood pressure			
Total population	41.3% (36.9-45.7)	32.1% (29.2-35.0)	28.6% (26.0-31.5)
Male	55.8% (44.1-67.2)	56.6% (47.9-65.1)	46.0% (37.1-55.1)
Female	38.6% (34.0-43.4)	28.3% (25.4-31.4)	26.3% (23.5-29.2)
Triglycerides			
Total population	17.7% (14.4-21.2)	17.8% (15.5-20.3)	15.9% (13.7-18.2)
Male	40.3% (29.2-52.1)	44.1% (35.6-52.9)	41.3% (32.6-50.4)
Female	13.6% (10.5-17.2)	13.8% (11.6-16.2)	12.5% (10.4-14.8)
Glucose			
Total population	8.9% (6.6-11.8)	9.5% (7.8-11.5)	8.0% (6.4-9.8)
Male	11.7% (5.5-21.0)	20.6% (14.1-23.4)	11.1% (6.2-18.0)
Female	8.4% (6.0-11.5)	7.8% (6.2-9.8)	7.5% (6.0-9.4)

Values are % (95% confidence interval)

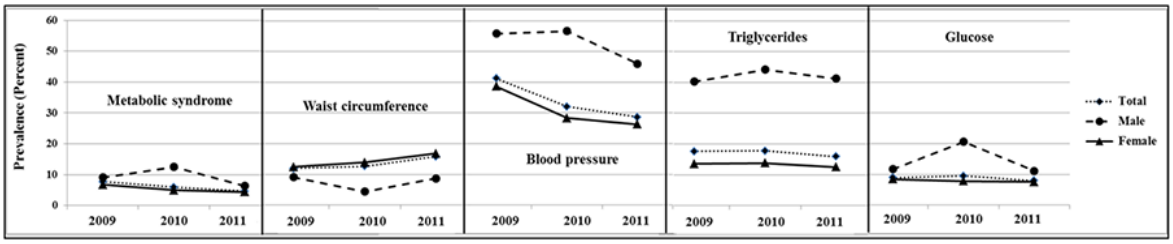

Fig. 1 Prevalence and trends of the components of metabolic syndrome.

(triglycerides, blood pressure and glucose) in personnel is a positive development. Clinical trials have suggested that a 1% decrease in LDL cholesterol translates into a 1% decrease in the relative risk of CHD[4]. However, further research is needed to explore the results.

Compared to a study in Thailand by Aekplakorn et al (2011)[18], the prevalence of MetS and its components in rural and urban areas was higher in females, especially in rural women. In that study, similar to ours, the most common combination of MetS components in men was the clustering of low HDL, hypertriglyceridemia, and high blood pressure whereas among women, the most common combination was the clustering of obesity, low HDL, and hypertriglyceridemia. The present study was similar to previous ones which found an increased prevalence of MetS with increasing age, which can be explained by a decline in physical activity and an increase in each individual component of MetS with advancing age[6,14,17].

We found that MetS was more prevalent in men than in women, consistent with other studies in Asian[19,20]. Gender difference may reflect the variations in eating speed of men and women. A study by Hill and McCutcheon reported that women took more bites, had a smaller bite size and took slower bites than men in eating the same amount of doughnut, resulting in larger body size[21]. Eating rate and speed may influence the metabolism of men more than of women.

Employment in office administration work is associated with a greater prevalence of MetS. Differences in the amount of physical activity performed

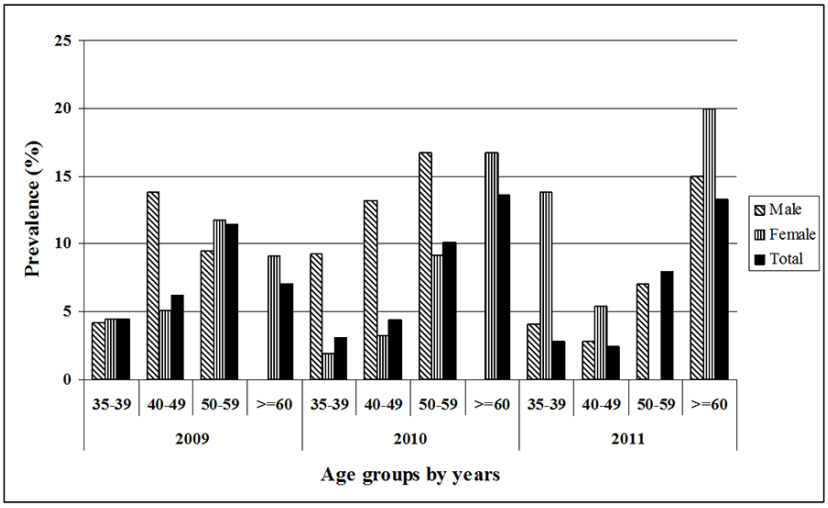

Fig. 2 Prevalence of metabolic syndrome divided by age groups.

appear to play a crucial role. Office workers, in general, tend to be less active and burn fewer calories than people in other occupations, which are not as sedentary. This is in agreement with the Copenhagen City Heart study for 10-year follow-up. The risk of developing MetS was reduced in subjects who practiced moderate or high leisure time physical activity such as walking or jogging. This information confirms the importance of recommendations for daily exercise[22].

A limitation of the study is that no data were available about HDL cholesterol, so that it is, therefore, impossible to define MetS using this criterion. Furthermore, only one plasma lipid measurement was performed in the present study, and this may not represent an entirely reliable picture of the participants' basic biological health status data, in particular for triglycerides and HDL-cholesterol levels, where a lifestyle dietary and exercise record is required to obtain representative parameters; as a result, the prevalence may be underestimated. In addition, this study is limited in that it did not take into account the use of cholesterol-lowering medication and hypertensive drugs among subjects. It appears that the decreases in some metabolic markers may have been influenced more by increased medication use rather than by positive lifestyle changes. However, further research is required to assess simultaneously the effects of lipid-lowering medications and other lifestyle factors on lipids.

The main strength of this study was its large sample size, and the fact that it was conducted in a single setting. To arrive at several definitions of the metabolic syndrome, waist circumference, triglyceride, blood pressure and glucose, which are used as criteria in the present study, are included in the collected data. Therefore, up to four of five criteria of MetS may be used as a screening test for Mets in the health of personnel.

The prevalence of metabolic syndrome was related to advancing age. Some criteria in the modified NCEP-ATP III, especially waist circumference, blood pressure, triglyceride levels and glucose, are risk factors of metabolic syndrome and should be avoided in order to decrease its prevalence. Moreover, it is crucial to orient the health systems toward recognizing the dangers of MetS and to empower personnel in the prevention and early control of its modifiable risk factors. As a super tertiary hospital, our personnel's health is important. Multidisciplinary teams and health care systems should be put in place to modify procedures in order to identify individuals at risk and initiate their treatment in a timely manner.

Acknowledgement

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What is already known on this topic ?

Previous studies have investigated the prevalence of metabolic syndrome and risk factors associated with it. However, its prevalence varied depending on study samples and geographical

settings.

What this study adds ?

This study determines the trend of metabolic syndrome over three years in one setting. We learnt about the change of each metabolic component over time.

Potential conflicts of interest

None.

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แนวโน้มขององค์ประกอบเมตาบอลิสมในบุคลากรโรงพยาบาลราชวิถี

จารุวรรณ หมั่นมี, พลอยภัสสร อินทร์วัน, กัญญา จันทร์พล

ภูมิหลัง: *ภาวะ metabolic syndrome (MetS) หรือภาวะอ้วนลงพุงเป็นการรวมกันของความผิดปกติทางสุขภาพและเพิ่มความเสี่ยงต่อโรคเบาหวาน จากการศึกษาที่ผ่านมาพบว่า ความชุกของภาวะ MetS มีความแตกต่างกันระหว่างกลุ่มประชากร แต่ปัจจัยด้านอายุที่เพิ่มขึ้นเป็นความเสี่ยงที่พบได้บ่อย ในการทบทวนวรรณกรรม การศึกษานี้มุ่งหวังประเมินแนวโน้มขององค์ประกอบเมตาบอลิสมในบุคลากร โรงพยาบาลราชวิถี*

วัสดุและวิธีการ: *การศึกษาภาคตัดขวาง (cross-sectional study) ข้อมูลระหว่างปี พ.ศ. 2552-2554 บุคลากรมีอายุตั้งแต่ 35 ปีขึ้นไป จำนวนบุคลากรปี 2552-2554 คือ 504, 1,029 และ 1,057 คน ตามลำดับ การเก็บรวบรวมข้อมูลจากประวัติการตรวจสุขภาพประจำปี การจำแนกภาวะ MetS โดยใช้เกณฑ์ใหม่ของ The National Cholesterol Educational Program Adult Treatment Panel III (NCEP-ATP III) วิเคราะห์ข้อมูลปัจจัยเสี่ยงต่อการเกิดภาวะ MetS ด้วย Binary logistic regression*

ผลการศึกษา: *บุคลากรส่วนใหญ่เป็นเพศหญิง อายุเฉลี่ย ± ส่วนเบี่ยงเบนมาตรฐาน ในปี 2552-2554 เป็น 45.8±7.6, 45.6±7.9 และ 46.1±7.1 ปี ตามลำดับ ค่าเฉลี่ย BMI, เส้นรอบเอว, ไตรกลีเซอไรด์, กลูโคส, กรดยูริค ในกลุ่มที่มีภาวะ MetS มีค่าสูงกว่ากลุ่มไม่มีภาวะ MetS ความชุกของภาวะ MetS ในปี 2552-2554 เป็น 7.8, 5.9 และ 4.6 ตามลำดับ องค์ประกอบของ MetS ด้านความดันโลหิตสูงพบมากที่สุดในเพศชายและหญิง เมื่อจำแนกตามเพศ องค์ประกอบด้านความดันโลหิตสูง ไตรกลีเซอไรด์และกลูโคสสูง พบมากในเพศชาย ขณะที่องค์ประกอบด้านความดันโลหิตสูง เส้นรอบเอวเกินมาตรฐานและไตรกลีเซอไรด์สูงพบมากในเพศหญิงความชุกของ MetS มีความสัมพันธ์กับอายุ เพศชาย และการปฏิบัติงานในกลุ่มภารกิจอำนวยการ*

สรุป: *ความชุกของภาวะ MetS ค่อนข้างต่ำและมีแนวโน้มลดลงตามปี ปัจจัยเสี่ยงต่อการเกิดภาวะ MetS คือ อายุที่เพิ่มขึ้น เพศชาย และการปฏิบัติงานในกลุ่มภารกิจอำนวยการ องค์ประกอบของภาวะ Mets คือ เส้นรอบเอว, ความดันโลหิต, ระดับไตรกลีเซอไรด์ และกลูโคส เป็นปัจจัยเสี่ยงที่มีผลต่อการเกิดภาวะอ้วนลงพุง จึงควรป้องกันเพื่อลดความชุกของภาวะ metabolic syndrome*