

Hypertension

# Prevalence and Characteristics of the Metabolic Syndrome in Chinese Hypertensive Patients: A Hospital-Based Observation

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**Background:** Hypertension is the key component of the metabolic syndrome (MS). Insulin resistance is regarded as the underlying pathophysiological basis of the clustering metabolic abnormalities associated with the MS. However, some antihypertensive agents may influence the insulin resistant state and the propensity for the development of type 2 diabetes. Therefore, it is clinically important to determine the relationships between hypertension and other features of the MS. In this study, we aimed to investigate the prevalence and characteristics of the MS in Chinese hypertensive patients.

**Methods and Results:** Four-hundred and twenty-six patients, 210 men and 216 women, taking antihypertensive agents to control blood pressure were analyzed according to the modified Adult Treatment Panel III criteria for the MS. The mean age was 65 years (25-95 years). The prevalence of the MS was 47.9%. There was a trend toward female predominance in the prevalence of the MS (52.3% vs 43.3%,  $p = 0.064$ ). Moreover, women had a significantly higher MS score ( $2.8 \pm 1.2$  vs  $2.4 \pm 1.2$ ,  $p = 0.002$ ). The prevalence of abdominal obesity was significantly higher in women than in men (74.1% vs 50.0%,  $p < 0.001$ ). The prevalence of high triglycerides, low high-density lipoprotein cholesterol (HDL-C), and high fasting blood sugar or treated diabetes was similar in both sexes. There were no differences in serum levels of creatinine, total cholesterol, low-density lipoprotein cholesterol, and non-HDL-C, left ventricular mass, and the rate of proteinuria between patients with and without the MS. In female patients, those with the MS had higher serum uric acid levels than those without the MS ( $6.5 \pm 2.2$  vs  $5.6 \pm 1.1$  mg/dL,  $p = 0.011$ ). This difference was shown as a trend but not statistically significant in male patients ( $7.1 \pm 2.0$  vs  $6.6 \pm 1.7$  mg/dL,  $p = 0.187$ ).

**Conclusions:** The MS was highly prevalent in Chinese hypertensive patients, especially in females. However, large-scale prospective studies are needed to verify these viewpoints.

**Key Words:** Hypertension • Insulin resistance • Metabolic syndrome • Uric acid

## INTRODUCTION

The National Cholesterol Education Program's Adult

Treatment Panel III report (ATP III) has identified the metabolic syndrome (MS) as a multicomplex risk factor for cardiovascular disease and deserving of more clinical attention.<sup>1</sup> Screening for and treatment of the MS may eventually prevent cardiovascular disease in affected subjects.<sup>2</sup> The MS affects about 1/5 of adults in the United States and 10-20% of adult Chinese population, with a higher prevalence in persons older than 60 years of age and in certain ethnic groups.<sup>3-7</sup> Hypertension is the key component of the MS. Insulin resistance is regarded as the underlying pathophysiological basis of the clustering metabolic abnormalities associated with the MS.<sup>1</sup> However, some antihypertensive agents,

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for example, diuretics or beta-adrenergic blocking agents, may worsen the insulin resistant state and increase the propensity for the development of type 2 diabetes.<sup>8</sup> On the other hand, alpha-1 adrenergic blockers, angiotensin converting enzyme inhibitors, and angiotensin II receptor antagonists may ameliorate insulin resistance,<sup>9</sup> whereas calcium channel blockers are neutral in this respect.<sup>10</sup> Therefore, it is clinically important to determine the relationships between hypertension and other features of the MS. To our knowledge, there was no previous study exploring the prevalence of the MS in Chinese hypertensive patients. In this study, we aimed to investigate the prevalence and characteristics of the MS in Chinese hypertensive patients. Findings from this study may have implications in the selection of antihypertensive agents for patients with hypertension.

## MATERIALS AND METHODS

### Patients

A total of 426 consecutive patients taking antihypertensive agents to control blood pressure followed in National Taiwan University Hospital were enrolled in this study. Four diagnostic criteria other than elevated blood pressure listed in the modified ATP III version of the MS were examined in each patient,<sup>11</sup> and the presence of any two or more of these factors was considered sufficient for diagnosis. These four criteria were (1) abdominal girth > 90 cm in male and > 80 cm in female, (2) high-density lipoprotein cholesterol (HDL-C) < 40 mg/dL in male and < 50 mg/dL in female, (3) fasting triglycerides  $\geq$  150 mg/dL, and (4) fasting plasma glucose  $\geq$  110 mg/dL or use of hypoglycemic agents. The MS score was defined as the number of the traits (the four above-mentioned diagnostic criteria and elevated blood pressure) that patients had. With written or verbal agreement, abdominal girth was measured halfway between the lowest costal margin and superior iliac crest,<sup>5</sup> and blood tests for total cholesterol, HDL-C, low-density lipoprotein cholesterol, triglycerides, creatinine, and uric acid, urinalysis for proteinuria, and echocardiography for the measurement of left ventricular mass were taken. In patients treated with lipid-lowering medications, blood samples were obtained after discontinuation of

lipid-lowering medications for at least 2 months, whereas antihypertensive medications were continued. Serum levels of total cholesterol, total triglycerides, low-density lipoprotein cholesterol and HDL-C were assayed by routine laboratory techniques using the methods of the Lipid Research Clinics, as reported previously.<sup>12</sup> If serum triglycerides were > 400 mg/dL, low-density lipoprotein cholesterol was assessed by a direct method.<sup>12</sup> Proteinuria was defined as  $\geq$  30 mg/dL on spot urine. Left ventricular hypertrophy was defined as posterior wall or septal wall thickness  $\geq$  12 mm.<sup>13</sup> Left ventricular mass was calculated with the equation:  $0.80 \times 1.04 \times [(\text{septal wall thickness} + \text{posterior wall thickness} + \text{left ventricular internal dimension})^3 - (\text{left ventricular internal dimension})^3] + 0.6$  g modified from the recommendation of American Society of Echocardiography.<sup>14,15</sup>

### Statistical analysis

All analyses were performed using the Software Package for the Social Science (SPSS for Windows 11.0, SPSS Institute, Chicago, IL, USA). For univariate analysis, Pearson chi-square test and Fisher's exact test were used for comparison of categorical variables, while Student's t-test was used for analysis of continuous variables. Homogeneity of variance was assessed by Levene's test. All tests were two-tailed, and *p* values of < 0.05 were considered statistically significant.

## RESULTS

Our study enrolled 426 patients, 210 men and 216 women, and the mean age was  $65.3 \pm 12.1$  years. The prevalence of individual abnormalities of the MS in both men and women were, respectively, as follows: abdominal obesity 50.0% vs 74.1% (*p* < 0.001), hypertriglyceridemia 39.7% vs 41.3% (*p* = 0.916), low HDL-C 74.6% vs 81.4% (*p* = 0.138), and high fasting plasma glucose or treated diabetes 42.0% vs 42.5% (*p* = 0.993) (Table 1). The prevalence of the MS in the present hypertensive cohort was 47.9%. There was a strong trend toward female predominance in the prevalence of the MS (52.3% vs. 43.3%, *p* = 0.064). Moreover, women had a significantly higher MS score ( $2.8 \pm 1.2$  vs  $2.4 \pm 1.2$ , *p* = 0.002). The prevalences of the MS in different age groups were similar: 48.3% in patients aged 70 years or more, 48.3% in

patients aged 60 to 69 years, and 47.0% in those under 60 years ( $p = 0.971$ ). As to the use of antihypertensive agents, there was a higher rate of alpha-1 adrenergic blocker use in male patients (15.2% vs 4.2%,  $p < 0.001$ ). This might be due to the dual effects of alpha-1 adrenergic blockers in lowering blood pressures and relieving the obstructive symptoms of benign prostatic hypertrophy. The use of alpha-1 adrenergic blockers had no correlation with lipid profiles or the prevalence of the MS. The rates of lipid-lowering agent use in men or women did not show any difference.

As shown in Table 2, there were no differences in

mean age ( $p = 0.971$ ), levels of total cholesterol ( $p = 0.986$ ) and LDL-C ( $p = 0.849$ ), LV mass ( $p = 0.881$ ), or the frequency of proteinuria ( $p = 0.867$ ) and antihypertensive agent use between patients with and without the MS. There was a trend toward higher serum levels of uric acid in patients with the MS ( $6.8 \pm 2.1$  vs  $6.2 \pm 1.6$  mg/dL,  $p = 0.088$ ). The values of abdominal girth, and serum levels of triglycerides, HDL-C, and fasting glucose (all  $p < 0.001$ ) were significantly higher in patients with the MS, as expected. Accordingly, the rates of statin and fibrate use in patients with the MS were significantly higher than those in patients without the MS.

**Table 1.** Demographics and characteristics of the study population

	Total	Male	Female	<i>p</i> value*
Case No.	426	210	216	
Age (years)	65.3 ± 12.1	63.7 ± 12.2	66.9 ± 11.9	0.007
MS (%)	47.9	43.3	52.3	0.064
MS score	2.6 ± 1.2	2.4 ± 1.2	2.8 ± 1.2	0.002
Abdominal obesity (%)	62.2	50.0	74.1	< 0.001
High TG (%)	40.5	39.7	41.3	0.916
Low HDL-C (%)	78.2	74.6	81.4	0.138
High fasting glucose or treated diabetes (%)	42.3	42.0	42.5	0.993
Treated hypertension	100.0	100.0	100.0	1.000
Abdominal girth (cm)	88.8 ± 10.0	90.7 ± 9.3	87.0 ± 10.3	< 0.001
Total cholesterol (mg/dL)	192.6 ± 40.7	187.4 ± 39.7	197.6 ± 41.1	0.041
TG (mg/dL)	155.6 ± 86.2	148.0 ± 88.4	162.8 ± 83.7	0.159
LDL-C (mg/dL)	109.5 ± 35.0	110.7 ± 32.1	108.5 ± 37.4	0.638
HDL-C (mg/dL)	38.9 ± 8.8	36.6 ± 7.9	40.8 ± 9.2	< 0.001
Non-HDL-C (mg/dL)	155.3 ± 37.1	152.8 ± 36.7	157.5 ± 37.6	0.331
Total cholesterol: HDL-C ratio	5.1 ± 1.2	5.3 ± 1.2	5.0 ± 1.1	0.041
Fasting glucose (mg/dL)	115.6 ± 46.1	114.7 ± 39.8	116.4 ± 51.4	0.768
Uric acid (mg/dL)	6.6 ± 2.0	6.9 ± 1.9	6.3 ± 2.0	0.015
Creatinine (mg/dL)	1.2 ± 0.8	1.4 ± 0.9	1.1 ± 0.8	0.026
Antihypertensive agent use				
α-adrenergic blocker (%)	9.6	15.2	4.2	< 0.001
β-adrenergic blocker (%)	38.7	39.5	38.0	0.741
Calcium channel blocker (%)	50.2	47.1	53.2	0.208
Diuretic (%)	29.3	26.2	32.4	0.159
ACEI (%) †	4.5	5.7	3.2	0.216
AIIRA (%) Δ	47.9	44.3	51.4	0.142
Others (%) #	4.0	3.8	4.2	0.351
Lipid-lowering agents &				
Statin (%)	29.3	32.9	25.9	0.116
Fibrate (%)	10.1	8.6	11.6	0.304
Resin (%)	0.2	0.5	0	0.493

\**p* (male vs female); † ACEI = angiotensin-converting enzyme inhibitor; Δ AIIRA = angiotensin II receptor antagonist; # including direct vasodilators and central-acting agents; & in patients treated with lipid-lowering agents, blood samples were obtained after discontinuation of lipid-lowering agents for at least 2 months.

The total cholesterol-to-HDL-C ratio, an important predictor of future coronary events,<sup>12</sup> was also significantly higher in patients with the MS.

Analyzing both men and women separately, there was still no difference in levels of total cholesterol and LDL-C, LV mass, or the frequency of proteinuria and antihypertensive agent use between patients with and without the MS. Male patients with the MS were younger ( $61.6 \pm 11.1$  vs  $65.4 \pm 12.7$  years,  $p = 0.027$ ), while female patients with the MS were older ( $68.4 \pm 11.0$  vs

$65.3 \pm 12.6$  years,  $p = 0.055$ ), though the difference was not statistically significant. Both male and female patients with the MS had higher serum levels of uric acid, though the difference in male patients was not statistically significant (men  $7.1 \pm 2.0$  vs  $6.6 \pm 1.7$  mg/dL,  $p = 0.187$ ; women  $6.5 \pm 2.2$  vs  $5.6 \pm 1.1$  mg/dL,  $p = 0.011$ ) (Tables 3 and 4). Correspondingly, the correlation between uric acid and triglycerides was more prominent in women ( $r = 0.31$ ,  $p = 0.002$ ) than in men ( $r = 0.15$ ,  $p = 0.148$ ) ( $r = 0.21$ ,  $p = 0.003$ , for all patients). The cor-

**Table 2.** Comparison of hypertensive patients with or without the metabolic syndrome

	MS	No MS	<i>p</i> value
Case No.	204	222	
Age (years)	$65.4 \pm 11.5$	$65.3 \pm 12.6$	0.971
MS score	$3.7 \pm 0.7$	$1.6 \pm 0.5$	< 0.001
Abdominal obesity (%)	82.3	43.8	< 0.001
High TG (%)	54.4	4.1	< 0.001
Low HDL-C (%)	92.9	31.6	< 0.001
High fasting glucose or treated diabetes (%)	11.3	53.6	< 0.001
Abdominal girth (cm)	$92.8 \pm 9.4$	$85.2 \pm 9.1$	< 0.001
Total cholesterol (mg/dL)	$192.6 \pm 41.5$	$192.7 \pm 38.6$	0.986
TG (mg/dL)	$179.1 \pm 88.6$	$94.1 \pm 33.5$	< 0.001
LDL-C (mg/dL)	$109.7 \pm 37.1$	$108.8 \pm 26.9$	0.849
HDL-C (mg/dL)	$36.4 \pm 6.8$	$46.6 \pm 10.0$	< 0.001
Non-HDL-C (mg/dL)	$157.2 \pm 38.5$	$149.4 \pm 32.0$	0.169
Total cholesterol: HDL-C ratio	$5.4 \pm 1.1$	$4.3 \pm 0.8$	< 0.001
Fasting glucose (mg/dL)	$122.1 \pm 49.8$	$98.8 \pm 29.1$	< 0.001
Uric acid (mg/dL)	$6.8 \pm 2.1$	$6.2 \pm 1.6$	0.088
Creatinine (mg/dL)	$1.23 \pm 0.8$	$1.25 \pm 0.9$	0.837
LVH (%)	16.67	14.00	0.801
LV mass (g)	$237.1 \pm 84.2$	$239.0 \pm 86.6$	0.881
Proteinuria (%)§	18.4	18.9	0.867
Anti-hypertensive agent			
$\alpha$ -adrenergic blocker (%)	7.8	11.3	0.232
$\beta$ -adrenergic blocker (%)	36.8	40.5	0.424
Calcium channel blocker (%)	51.0	49.5	0.768
Diuretic (%)	30.9	27.9	0.503
ACEI (%) $\epsilon$	5.9	3.2	0.173
AIIIRA (%) $\Delta$	51.0	45.2	0.221
Others (%) #	4.4	3.6	0.670
Lipid-lowering agents &			
Statin (%)	35.8	23.4	0.005
Fibrate (%)	17.6	3.2	< 0.001
Resin (%)	0	0.5	1.000

|| equal to  $0.80 \times 1.04 \times [(\text{septal wall thickness} + \text{posterior wall thickness} + \text{left ventricular internal dimension})^3 - (\text{left ventricular internal dimension})^3] + 0.6$  g; § defined as  $\geq 30$  mg/dL on spot urine;  $\epsilon$  ACEI = angiotensin-converting enzyme inhibitor;  $\Delta$  AIIIRA = angiotensin II receptor antagonist; # including direct vasodilators and central-acting agents; & in patients treated with lipid-lowering agents, blood samples were obtained after discontinuation of lipid-lowering agents for at least 2 months.

**Table 3.** Comparison of male hypertensive patients with and without the metabolic syndrome

	MS	No MS	<i>p</i> value
Case No.	91	119	
Age (years)	61.6 ± 11.1	65.3 ± 12.7	0.027
MS score	3.6 ± 0.7	1.5 ± 0.5	< 0.001
Abdominal obesity (%)	73.3	31.9	< 0.001
High TG (%)	59.0	6.3	< 0.001
Low HDL-C (%)	92.1	35.3	< 0.001
High fasting glucose or treated diabetes (%)	57.6	13.0	< 0.001
Abdominal girth (cm)	95.4 ± 8.9	87.2 ± 7.9	< 0.001
TG (mg/dL)	177.9 ± 95.8	95.7 ± 34.6	< 0.001
Total cholesterol (mg/dL)	188.2 ± 39.3	186.2 ± 41.0	0.785
LDL-C (mg/dL)	112.5 ± 33.3	106.1 ± 29.1	0.367
HDL-C (mg/dL)	33.9 ± 5.7	42.6 ± 8.9	< 0.001
Non-HDL-C (mg/dL)	155.3 ± 38.2	146.9 ± 32.6	0.273
Total cholesterol: HDL-C ratio	5.6 ± 1.2	4.5 ± 0.7	< 0.001
Fasting glucose (mg/dL)	122.4 ± 40.9	100.8 ± 34.0	0.002
Uric acid (mg/dL)	7.1 ± 2.0	6.6 ± 1.7	0.187
Creatinine (mg/dL)	1.4 ± 1.0	1.3 ± 0.6	0.465
LVH (%)	20.5	21.1	0.834
LV mass (g)	271.2 ± 90.4	267.8 ± 95.9	0.859
Proteinuria (%) §	17.7	22.7	0.926
Anti-hypertensive agent			
α-adrenergic blocker (%)	11.1	18.3	0.150
β-adrenergic blocker (%)	41.1	38.3	0.684
Calcium channel blocker (%)	48.9	45.8	0.661
Diuretic (%)	22.2	29.2	0.257
ACEI (%) ϕ	8.9	3.3	0.131
AIIRA (%) Δ	43.3	45.0	0.810
others (%) #	2.2	5.0	0.471
Lipid-lowering agents &			
Statin (%)	39.6	27.7	0.056
Fibrate (%)	14.3	4.2	0.008
Resin (%)	0	0.8	1.000

|| equal to  $0.80 \times 1.04 \times [(\text{septal wall thickness} + \text{posterior wall thickness} + \text{left ventricular internal dimension})^3 - (\text{left ventricular internal dimension})^3] + 0.6$  g; § defined as  $\geq 30$  mg/dL on spot urine; ϕ ACEI = angiotensin-converting enzyme inhibitor; Δ AIIRA = angiotensin II receptor antagonist; # including direct vasodilators and central-acting agents; & in patients treated with lipid-lowering agents, blood samples were obtained after discontinuation of lipid-lowering agents for at least 2 months.

relation between uric acid and abdominal girth was also significant ( $r = 0.28$ ,  $p < 0.001$ ), and more prominent in women ( $r = 0.33$ ,  $p = 0.001$ ) than in men ( $r = 0.173$ ,  $p = 0.086$ ).

## DISCUSSION

The high incidence of the MS and its impact on cardiovascular disease found in previous surveys in both eastern and western countries underscore the impor-

tance of this diagnosis.<sup>1-5,7,16</sup> Additionally, the rapidly escalating incidence of obesity in recent years has made it a more and more prevalent problem. Using the euglycemic hyperinsulinemic clamp procedure to assess insulin sensitivity, Lind et al. found that 31% of 420 untreated middle-aged hypertensive patients were insulin-resistant.<sup>17</sup> In this study, the prevalence of the MS, diagnosed by clinical criteria, in Chinese hypertensive patients was 47.9%, which was similar to that in Caucasian hypertensive and/or obese subjects reported by Jermendy et al.<sup>2</sup> Their study showed non-significant

**Table 4.** Comparison of female hypertensive patients with and without the metabolic syndrome

	MS	No MS	<i>p</i> value
Case No.	113	103	
Age (years)	68.4 ± 11.0	65.3 ± 12.6	0.055
MS score	3.7 ± 0.7	1.7 ± 0.5	< 0.001
Abdominal obesity (%)	89.4	58.0	< 0.001
High TG (%)	50.9	0.0	< 0.001
Low HDL-C (%)	93.4	26.1	< 0.001
High fasting glucose or treated diabetes (%)	50.5	8.0	< 0.001
Abdominal girth (cm)	90.7 ± 9.4	82.9 ± 9.8	< 0.001
TG (mg/dL)	180.0 ± 83.3	91.4 ± 32.1	< 0.001
Total cholesterol (mg/dL)	196.0 ± 43.1	203.7 ± 32.1	0.300
LDL-C (mg/dL)	107.6 ± 39.8	112.5 ± 23.8	0.457
HDL-C (mg/dL)	38.2 ± 7.0	52.1 ± 8.8	< 0.001
Non-HDL-C (mg/dL)	158.5 ± 38.9	152.9 ± 31.4	0.507
Total cholesterol: HDL-C ratio	5.2 ± 1.0	4.0 ± 0.8	< 0.001
Fasting glucose (mg/dL)	121.8 ± 55.7	95.7 ± 19.2	< 0.001
Uric acid (mg/dL)	6.5 ± 2.2	5.6 ± 1.1	0.011
Creatinine (mg/dL)	1.1 ± 0.5	1.2 ± 1.2	0.490
LVH (%)	14.3	4.6	0.167
LV mass (g)	213.8 ± 71.4	200.7 ± 53.0	0.317
Proteinuria (%) §	19.1	13.3	0.661
Anti-hypertensive agent			
α-adrenergic blocker (%)	5.3	2.9	0.505
β-adrenergic blocker (%)	33.3	43.1	0.138
Calcium channel blocker (%)	52.6	53.9	0.850
Diuretic (%)	37.7	26.5	0.078
ACEI (%) ϕ	3.5	2.9	1.000
AIIA (%) Δ	57.0	45.1	0.080
others (%) #	6.1	2.0	0.177
Lipid-lowering agents &			
Statin (%)	32.7	18.4	0.021
Fibrate (%)	20.4	1.9	< 0.001
Resin (%)	0	0	

|| equal to  $0.80 \times 1.04 \times [(\text{septal wall thickness} + \text{posterior wall thickness} + \text{left ventricular internal dimension})^3 - (\text{left ventricular internal dimension})^3] + 0.6$  g; § defined as  $\geq 30$  mg/dL on spot urine; ϕ ACEI = angiotensin-converting enzyme inhibitor; Δ AIIA = angiotensin II receptor antagonist; # including direct vasodilators and central-acting agents; & in patients treated with lipid-lowering agents, blood samples were obtained after discontinuation of lipid-lowering agents for at least 2 months.

predominance of prevalence in female gender, and similar prevalence in all age groups, which are consistent with our findings. We further demonstrated that female hypertensive patients did have higher MS score, which had been related to more severe coronary angiographic alterations and higher frequencies of unstable angina and myocardial infarction.<sup>18</sup> It is noteworthy that male hypertensive patients with the MS were younger than those without in this study. This may only be a chance finding and needs further investigation.

As compared to those reported by Ford et al. and

Chuang et al. in general population,<sup>6,7</sup> the prevalences of all markers of the MS were significantly higher in our hypertensive patients. This may indicate that a substantial proportion of patients developing clinically evident hypertension are associated with insulin resistance. According to our and other studies, low HDL-C was the most frequently identified (more than three-fourth) marker of the MS in hypertensive patients.<sup>2,18</sup> Hypertriglyceridemia was identified in nearly 40% of hypertensive patients, while LDL-C was not elevated significantly. These lipid abnormalities, so-called

atherogenic dyslipidemia, need to be treated based on the ATP III guidelines.<sup>1</sup> Antihypertensive agents associated with adverse effects on lipid profiles, like beta blockers, should be used with caution in patients with atherogenic dyslipidemia, unless compelling indications are identified.<sup>19</sup> Despite one previous study which also demonstrated a higher prevalence of low HDL-C in hypertensive patients,<sup>20</sup> the correlation between hypertension and HDL-C remains controversial.<sup>21,22</sup>

It is noteworthy that female patients with the MS had significantly higher levels of uric acid as compared to those without the MS. This finding stood even after excluding the confounding effect of diuretics use. In fact, there was no significant difference regarding the frequency of diuretic use between patients with and without the MS. Serum levels of uric acid had been found to be markedly related to parameters of the MS, particularly serum triglycerides.<sup>19</sup> This association was also demonstrated in our study. A plethora of evidence suggest that serum uric acid level is an independent predictor of cardiovascular death, mainly for women, and is linked with the MS.<sup>23,24</sup> Therefore, in selecting antihypertensive agents, the risk of exacerbation of hyperuricemia, especially in female patients with the MS, should be seriously considered.

There were some limitations in this study. Firstly, all patients were recruited by a single physician from one tertiary referral center, which might inevitably introduce selection bias and result in the inclusion of more severe patients and a higher prevalence of the MS. Secondly, most patients in this study were treated by more than one antihypertensive agent. It is well known that beta-adrenergic blocking agents and diuretics are associated with adverse effects on insulin sensitivity and lipid profiles (increasing levels of triglycerides and decreasing levels of HDL-C),<sup>8,25</sup> whereas alpha-blocking agents have favorable effects on these features.<sup>9,10,26</sup> Because antihypertensive agents were not discontinued during blood sampling, the relationships between different biochemical variables and the MS might therefore be confounded. However, since there was no significant difference in the frequency of antihypertensive agent use between patients with and without the MS, the influence might be negligible. Thirdly, in patients treated with lipid-lowering agents, blood samples were obtained after discontinuation of lipid-lowering agents for at least 2

months. It is not known whether such a period of discontinuance will completely abolish the effects of lipid-lowering agents on plasma lipid profiles. However, because the frequency of statins and fibrates use was much higher in patients with the MS, the observed higher prevalence of low HDL-C and hypertriglyceridemia in patients with the MS might be even underestimated if the lipid-modifying effects of both statins and fibrates persisted.

In conclusion, the MS was highly prevalent (~50%) in Chinese hypertensive patients, especially in females. Women also had a higher MS score, which provides a clinically useful index of the severity of the MS and correlates with the angiographic severity of coronary atherosclerosis and its clinical complications.<sup>27</sup> Also, serum levels of uric acid were higher in patients with the MS, and more prominent in women. Considering the additional impact of the MS and hyperuricemia on the development of future cardiovascular diseases, we speculate that more aggressive treatment for female hypertensive patients may be warranted. Moreover, antihypertensive agents which may worsen insulin resistance or hyperuricemia should be used with caution in hypertensive patients with the MS. However, large-scale prospective studies are needed to verify these viewpoints.

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## 華人高血壓病患中代謝症候群的盛行率與臨床特徵

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**背景** 高血壓是代謝症候群的主要成份，而胰島素阻抗是造成代謝症候群之代謝異常的病理基礎。然而，有些降血壓藥物會影響胰島素阻抗的程度及升高病患發生第二型糖尿病的機會。所以，了解高血壓病人和代謝症候群的相關性有其臨床上的重要性。本篇研究的目的即在調查華人高血壓病患中代謝症候群的盛行率和臨床特徵。

**方法和結果** 我們收錄了 210 位男性和 216 位女性共 426 位服用降血壓藥物來控制高血壓的病人，並根據修正後的美國國家膽固醇教育計畫 III 中代謝症候群的診斷標準來做分析。平均年齡是 65 歲 (25-95 歲)。代謝症候群的盛行率是 47.9%。其中，女性病患的代謝症候群盛行率有較男性高的趨勢 (52.3% vs 43.3%,  $p = 0.064$ )。此外，女性的代謝症候群分數也顯著高於男性 ( $2.8 \pm 1.2$  vs  $2.4 \pm 1.2$ ,  $p = 0.002$ )。女性腹部肥胖的比率明顯地比男性高 (74.1% vs 50.0%,  $p < 0.001$ )。高三酸甘油酯，高密度脂蛋白膽固醇過低，及高空腹血糖或治療中之糖尿病的盛行率在兩性中則無顯著差別。不論病患有無代謝症候群，血中肌酸酐，總膽固醇，低密度脂蛋白膽固醇或非高密度脂蛋白膽固醇的濃度，左心室重量和蛋白尿的比例並無不同。女性病患中有代謝症候群者，其血清尿酸濃度較無代謝症候群者高 ( $6.5 \pm 2.2$  vs  $5.6 \pm 1.1$  mg/dL,  $p = 0.011$ )。男性病患在血清尿酸濃度上也有類似的差別，但並未達到統計學上的顯著意義 ( $7.1 \pm 2.0$  vs  $6.6 \pm 1.7$  mg/dL,  $p = 0.187$ )。

**結論** 代謝症候群在華人高血壓病患中，特別是女性，有很高的盛行率。惟這些觀點仍待大規模的前瞻性臨床研究檢驗其正確性。

**關鍵詞：**高血壓、胰島素阻抗、代謝症候群、尿酸。