

Prevalence of Metabolic Syndrome and Its Relationship with Cardiovascular Disease among Hypertensive Patients 55-80 Years of Age

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Patients with metabolic syndrome (MetS) are at an increased risk for developing cardiovascular disease (CVD). This study sought to assess the prevalence of MetS, and its association with CVD in older hypertensive subjects in Taiwan. We conducted a hospital-based cross-sectional study of 3,472 hypertensive patients age 55-80 years (1,763 men, 1,709 women), from 38 sites across Taiwan from November 2005-December 2006. MetS was defined using the modified criteria of the US National Cholesterol Education Program (NCEP) Adult Treatment Panel III, and the International Diabetes Federation (IDF). CVD included a diagnosis of angina pectoris (AP), myocardial infarction (MI), congestive heart failure (CHF), and stroke. The prevalence of MetS based on the modified NCEP criteria was 73.13% (68.29% in men, 78.12% in women). Use of the revised IDF definition significantly decreased the prevalence to 54.67% (46.63% in men, 62.96% in women). Subjects with MetS defined by IDF, or both criteria, had significantly higher odds ratios (ORs) of AP, CHF and all CVD. ORs of AP, MI, stroke, CHF, and all CVD were all significantly increased in subjects with MetS based on NCEP criteria. Those patients who met the NCEP, but not the IDF criteria, had a significantly elevated OR for MI. In contrast, those who met the IDF, but not the NCEP criteria did not have a significantly elevated OR for any CVD. MetS is highly prevalent in hypertensive patients 55-80 years of age in Taiwan, particularly women. Patients with MetS defined by either criteria have significantly higher ORs for CHF, AP and all CVD than those without MetS. Accordingly, NCEP criteria seems to be more suitable than IDF criteria for estimating cardiovascular risks in this Taiwanese population.

Key Words: Cardiovascular disease • Hypertension • Metabolic syndrome • Prevalence

INTRODUCTION

Metabolic syndrome (MetS) is a cluster of cardiovascular risk factors for cardiovascular disease (CVD), and is associated with increased risk of all-cause and cardiovascular mortality.¹⁻³ High blood pressure is a classical feature of MetS, and MetS is present in up to one third of hypertensive patients in western populations.^{4,5} The increasing prevalence of MetS due to the marked shift in lifestyle in Asian countries, caused by economic growth, affluence, urbanization, and westernization of diet, may lead to an increase in hypertension-induced CVD and its complications. Current international guidelines recommend MetS screening of all

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hypertensive patients for the identification of persons at high, long-term risk of CVD. Thus, identification of high-risk patients with hypertension may contribute to the development of more effective strategies for decreasing hypertension-related CVD risk.

Two definitions of MetS have been proposed by the World Health Organization (WHO) and the US National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), in 1999 and 2001, respectively.^{6,7} Recently, the International Diabetes Federation (IDF) recommended a new definition of MetS, that includes central obesity as a prerequisite and lowers the threshold for impaired fasting glucose (IFG) from 110 to 100 mg/dl.⁸ However, the impact of changing the criteria for MetS has not been rigorously evaluated, and its wisdom has been called into question due to fears it could increase the population at risk, particularly in Asian subjects. The definition of abdominal obesity was modified according to the 2000 WHO Asia Pacific Guidelines as a waist circumference ≥ 90 cm in men and ≥ 80 cm in women, because the absolute risk of diabetes and CVD is relatively higher in an Asian subject for a given waist circumference.⁹ The modified definition of abdominal obesity was also applied to modified NCEP and revised IDF criteria in China and Taiwan.^{10,11}

To date, very few studies have compared the prevalence defined by the modified NCEP ATP III criteria with that prevalence defined by the revised IDF criteria in hypertensive subjects in Asia. Indeed, the impact of MetS on CVD outcome in this hypertensive cohort has not been studied extensively. In this study, we investigated the prevalence of MetS as defined by NCEP ATP III and IDF criteria, and examined the relationship between MetS and CVD in a hospital-based survey of patients 55-80 years of age with hypertension in Taiwan.

METHODS

Study population

This study was a prospective, nationwide, cross-sectional, hospital-based, multicenter survey conducted in 38 sites across Taiwan from November 2005-December 2006. A total of 3,472 subjects 55-80 years of age (1,763 men, 1,709 women) were enrolled from the out-

patient clinics of the cardiology and neurology departments of participating study sites. To be included, participants were diagnosed with hypertension, defined as either currently receiving treatment for hypertension, or a blood pressure $\geq 140/90$ mm Hg, as determined using standardized techniques after subjects had been in a seated position for at least 10 min. Participants were required to have the capacity to understand and answer the health survey questionnaire used in this study, and be willing to sign an informed consent form. The protocol was approved by the ethics committee of each participating center, and prior written informed consent was obtained from all patients.

Collection of data

All data were collected by trained and certified staff. After providing their informed consent, all patients underwent the following procedures: (1) accurate medical history (implemented by a structured questionnaire on demographic and clinical characteristics, including questions concerning duration of hypertension, smoking status, and physical exercise level); (2) physical examination; (3) blood pressure measurement; (4) standard 12-lead ECG; and (5) blood chemistry examination after an overnight fast, including measurement of serum lipids (total cholesterol, triglycerides, high-density lipoprotein cholesterol [HDL-C], low-density lipoprotein cholesterol [LDL-C]) and glucose using standard enzymatic methods.

Anthropometric measures

Body mass index (BMI) and anthropometric measurements, i.e., height (without shoes) and weight (with heavy clothing removed) were obtained from the subjects. BMI cutoffs were adopted as suggested by the Department of Health in Taiwan, and subjects were categorized as normal ($18.5 \text{ kg/m}^2 \leq \text{BMI} < 24 \text{ kg/m}^2$), overweight ($24 \text{ kg/m}^2 \leq \text{BMI} < 27 \text{ kg/m}^2$), and obese ($\text{BMI} \geq 27 \text{ kg/m}^2$). Waist circumference was measured with a soft tape at the level of the umbilicus, at the end of a relaxed expiration while subjects were standing.

Definition of MetS

The diagnosis of MetS was established based on two definitions, the modified NCEP-ATP-III definition¹⁰ and the revised MS-IDF (MetS definition by the IDF criteria,

Chinese version) definition, incorporating the lower threshold for IFG (≥ 100 mg/dl).¹¹ Because all participants were hypertensive patients, the first definition of MetS, according to the modified NCEP-ATP III criteria for Asians, required meeting at least two of the following four component risk factors: (1) waist circumference ≥ 90 cm for men and ≥ 80 cm for women; (2) triglycerides ≥ 150 mg/dl or current use of lipid lowering medications; (3) HDL-C < 40 mg/dl for men and < 50 mg/dl for women; and (4) fasting plasma glucose ≥ 100 mg/dl or current use of antihyperglycemic drugs. The second definition of MetS used the revised IDF criteria: a hypertensive subject was considered to have MetS if they had abdominal obesity (waist circumference ≥ 90 cm in men, ≥ 80 cm in women for Chinese people) plus any one of the remaining three factors (the criteria for hypertriglyceridemia and reduced HDL-C were the same as for NCEP-ATP III, but the criterion for raised fasting plasma glucose was ≥ 100 mg/dl). We did not implement the WHO criteria⁸ for MetS because it requires oral glucose tolerance testing, which was not performed in our study cohort. We did not include lipid-lowering therapy in the criteria, because of the inability to collect accurate information regarding this parameter by personal interview.

Diagnosis of CVD

CVD was defined by the presence of one or more of four conditions: angina pectoris [AP; without history of myocardial infarction (MI)], MI, congestive heart failure (CHF), and stroke. The diagnosis of coronary artery disease and stroke was made according to WHO MONICA criteria.¹² MI was defined as clinical symptoms of myocardial ischemia with elevated serum cardiac enzymes and ECG changes. Angina was defined as ischemic cardiac pain with diagnostic exercise ECG, or stress perfusion imaging findings compatible with myocardial ischemia. The diagnosis of CHF was based on self-reports of a history of new, or aggravation of symptoms compatible with heart failure with supportive documentation, confirmed by hospital medical records and further clinical examinations, such as chest radiograph or echocardiographic changes, carried out at the time of the survey. Strokes were defined as events of neurological deficits requiring hospitalization, and this diagnosis was confirmed using computed tomography and magnetic resonance imaging.

Statistical analysis

Data were expressed as means \pm standard deviation, or as the number of cases and percent (percentage) of individuals affected. Age and sex-specific prevalence of MetS was determined using modified NCEP and revised IDF criteria. The *t* test and χ^2 test were used to examine differences in continuous and categorical variables, respectively, between men and women. Multivariate logistic regression analyses were used to calculate odds ratios (ORs) and their 95% confidence intervals (CI), with adjustment for potential confounders such as age, sex, smoking, physical exercise, and family history of stroke. Calculations were performed using the Statistical Package for the Social Sciences software (version 15, SPSS Inc., Chicago, IL, USA). A value of $p < 0.05$ was considered statistically significant.

RESULTS

Baseline characteristics

Demographics and characteristics of the 3,472 subjects (1,763 men, 1,709 women) are presented in Table 1. There were significant differences between men and women in most of the covariates. Men had significantly higher rates of physical exercise and smoking, higher waist circumference, BMI, and serum uric acid concentration, were more likely to have a history of coronary artery disease and stroke, and to have received antiplatelet medications. Women had significantly higher systolic blood pressure and serum cholesterol (including LDL-C and HDL-C).

Prevalence of MetS and its components

The proportions of the 3,472 Taiwanese older hypertensive subjects with individual components of MetS are shown in Table 2. Except for pre-existing hypertension, 94.35% and 90.75% of subjects had at least one component of MetS that was identified by modified NCEP criteria and revised IDF criteria, respectively. Most of the participants (about 70%) had one or two additional components of MetS. There was no clear age-related increase in the prevalence of individual components of MetS. In contrast, significant differences between the sexes were observed: women had a higher prevalence of dyslipidemia (low HDL-C), and central obesity. There-

fore, based on both NCEP and IDF criteria, the prevalence of MetS components were higher in women than in men. The prevalence of MetS by modified NCEP criteria was 73.13% (68.29% in men, 78.12% in women). Use of the revised IDF definition significantly decreased the prevalence of MetS to 54.67% (46.63% in men, 62.96% in women).

ORs for MetS by NCEP and IDF criteria associated with CVDs are shown in Table 3. The ORs for AP, MI, stroke, CHF, and all CVD in subjects with MetS using

the NCEP criteria were 1.33 (95% CI 1.1-1.62), 2.04 (95% CI 1.38-3.02), 1.4 (95% CI 1.15-1.7), 1.37 (95% CI 1.01-1.85), and 1.4 (95% CI 1.2-1.63), respectively. Corresponding ORs using the IDF criteria were 1.33 (95% CI 1.12-1.57), 0.98 (95% CI 0.74-1.32), 1.12 (95% CI 0.95-1.33), 1.32 (95% CI 1.02-1.71), and 1.23 (95% CI 1.07-1.40), respectively. Subjects with MetS defined by IDF or both criteria, had significantly higher odds of AP, CHF and all CVD. Odds of AP, MI, stroke, CHF, and all CVD were all significantly increased in

Table 1. Demographic, anthropometric, and biochemical characteristics of the subjects

Characteristic	Men (<i>n</i> = 1763)	Women (<i>n</i> = 1709)	p-value
Age (years)	67.4 ± 7.2	67.3 ± 6.8	0.4910
Age-adjusted variables			
Systolic blood pressure (mm Hg)	136.7 ± 16.0	138.9 ± 16.4	< 0.0001
Diastolic blood pressure (mm Hg)	80.8 ± 10.1	80.7 ± 9.9	0.8957
Total cholesterol (mg/dl)	191.1 ± 38.1	201.3 ± 39.3	< 0.0001
Triglycerides (mg/dl)	149.8 ± 123.5	151.5 ± 83.1	0.7900
HDL cholesterol (mg/dl)	46.9 ± 12.6	54.2 ± 14.1	< 0.0001
LDL cholesterol (mg/dl)	118.5 ± 35.7	123.1 ± 35.7	0.0030
Fasting glucose (mg/dl)	118.8 ± 41.6	121.1 ± 42.9	0.1136
Waist circumference (cm)	93.9 ± 9.4	89.9 ± 10.8	< 0.0001
Body mass index	25.9 ± 3.4	26.3 ± 4.0	0.0013
Physical exercise (number/total)			< 0.0001
Does not exercise at all	205/1758 (11.66)	323/1698 (19.02)	
Minimal irregular exercise (< 30 min per week)	497/1758 (28.27)	534/1698 (31.45)	
Regular exercise (> 30 min twice per week)	1056/1758 (60.07)	841/1698 (49.53)	
Duration of hypertension			0.3273
< 1 year	161 (9.18)	133 (7.80)	
1-5 years	578 (32.95)	562 (32.94)	
> 5 years	1015 (57.87)	1011 (59.26)	
Current smoker (number/total)	448/1758 (25.48)	27/1706 (1.58)	< 0.0001
Uric acid (mg/dl)	6.8 ± 2.5	6.0 ± 2.1	< 0.0001
Left ventricular hypertrophy on ECG (number/total)	115/1753 (6.56)	90/1695 (5.31)	0.1206
Disease history (number/total)			
Family history of stroke	478/1697 (28.17)	414/1654 (25.03)	0.0399
Diabetes mellitus	496/1748 (28.38)	541/1696 (31.90)	0.0242
Coronary heart disease	402/1721 (23.36)	342/1678 (20.38)	0.0358
Stroke	482/1733 (27.81)	232/1691 (13.72)	< 0.0001
Medications (number/total)			
Anti-hypertension medications	1736/1754 (98.97)	1687/1705 (98.94)	0.9319
Lipid-lowering medications	447/1763 (25.35)	458/1709 (26.80)	0.3323
Statins	378/1763 (21.44)	402/1709 (23.52)	0.1417
Fibrates	73/1763 (4.14)	53/1709 (3.10)	0.1016
Anti-platelet medications	910/1763 (51.62)	670/1709 (39.20)	< 0.0001

Data are presented as mean ± standard deviation or number with percentage in parentheses.

HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Metabolic Syndrome in Hypertensive Patients in Taiwanese Population

Table 2. Age- and sex-specific prevalence of individual components, and the number (%) of components, of metabolic syndrome based on the NCEP and IDF criteria in hypertensive patients 55-80 years of age

	Men (50.78%)				Women (49.22%)				Men and women (n = 3472)
	55-64 years (n = 649)	65-74 years (n = 735)	75-80 years (n = 379)	Total (n = 1763)	55-64 years (n = 631)	65-74 years (n = 771)	65-80 years (n = 307)	Total (n = 1709)	
MetS components other than HTN									
Hyperglycemia (glucose \geq 110 mg/dl)	268 (42.27%)	336 (46.22%)	152 (40.75%)	756 (43.60%)	262 (42.33%)	361 (47.63%)	144 (47.37%)	767 (45.63%)	1523 (44.60%)
Hyperglycemia (glucose \geq 100 mg/dl)	397 (62.62%)	489 (67.26%)	233 (62.47%)	1119 (64.53%)	392 (63.33%)	516 (68.07%)	212 (69.74%)	1120 (66.63%)	2239 (65.56%)
Hypertriglyceridemia	249 (38.37%)	246 (33.47%)	89 (23.48%)	584 (33.13%)	227 (35.97%)	298 (38.65%)	97 (31.60%)	622 (36.40%)	1206 (34.74%)
Low HDL cholesterol	461 (71.03%)	490 (66.67%)	229 (60.42%)	1180 (66.93%)	440 (69.73%)	580 (75.23%)	220 (71.66%)	1240 (72.56%)	2420 (69.70%)
Central obesity by NCEP	425 (65.49%)	504 (68.57%)	239 (63.06%)	1168 (66.25%)	514 (81.46%)	651 (84.44%)	267 (86.97%)	1432 (83.79%)	2600 (74.88%)
Central obesity by IDF	401 (62.56%)	464 (63.39%)	222 (59.20%)	1087 (62.19%)	493 (78.25%)	631 (82.38%)	258 (84.59%)	1382 (81.25%)	2469 (71.59%)
Number of components of MetS by NCEP	461 (71.03%)	520 (70.75%)	223 (58.84%)	1204 (68.29%)	473 (74.96%)	620 (80.42%)	242 (78.83%)	1335 (78.12%)	2539 (73.13%)
HTN only	46 (7.09%)	56 (7.62%)	31 (8.18%)	133 (7.54%)	29 (4.60%)	25 (3.24%)	9 (2.93%)	63 (3.69%)	196 (5.65%)
HTN and 1 more	142 (21.88%)	159 (21.63%)	125 (32.98%)	426 (24.16%)	129 (20.44%)	126 (16.34%)	56 (18.24%)	311 (18.20%)	737 (21.23%)
HTN and 2 more	208 (32.05%)	232 (31.56%)	109 (28.76%)	549 (31.14%)	202 (32.01%)	229 (29.70%)	101 (32.90%)	532 (31.13%)	1081 (31.13%)
HTN and 3 more	167 (25.73%)	199 (27.07%)	90 (23.75%)	456 (25.87%)	174 (27.58%)	258 (33.46%)	94 (30.62%)	526 (30.78%)	982 (28.28%)
HTN and 4 more	86 (13.25%)	89 (12.11%)	24 (6.33%)	199 (11.29%)	97 (15.37%)	133 (17.25%)	47 (15.31%)	277 (16.21%)	476 (13.71%)
Numbers of components of MetS by IDF	308 (47.46%)	355 (48.30%)	159 (41.95%)	822 (46.63%)	368 (58.32%)	497 (64.46%)	211 (68.73%)	1076 (62.96%)	1898 (54.67%)
HTN only	87 (13.41%)	87 (11.84%)	57 (15.04%)	231 (13.10%)	45 (7.13%)	50 (6.49%)	17 (5.54%)	112 (6.55%)	343 (9.88%)
HTN and 1 more	217 (33.44%)	249 (33.88%)	141 (37.20%)	607 (34.43%)	193 (30.59%)	201 (26.07%)	73 (23.78%)	467 (27.33%)	1074 (30.93%)
HTN and 2 more	233 (35.90%)	280 (38.10%)	143 (37.73%)	656 (37.21%)	250 (39.62%)	311 (40.34%)	148 (48.21%)	709 (41.49%)	1365 (39.31%)
HTN and 3 more	91 (14.02%)	112 (15.24%)	33 (8.71%)	236 (13.39%)	122 (19.33%)	173 (22.44%)	53 (17.26%)	348 (20.36%)	584 (16.82%)
HTN and 4 more	21 (3.24%)	7 (0.95%)	5 (1.32%)	33 (1.87%)	21 (3.33%)	36 (4.67%)	16 (5.21%)	73 (4.27%)	106 (3.05%)

MetS, metabolic syndrome; HTN, hypertension; NCEP, National Cholesterol Education Program; IDF, International Diabetes Federation.

Table 3. Odds ratios (95% confidence intervals) of the history of congestive heart failure, angina, myocardial infarction, prior stroke/transient ischemic attack, and cardiovascular disease as risk factors for metabolic syndrome (MetS) in hypertensive patients (N = 3472)

Comparison		MetS by NCEP (n = 2539)	MetS by IDF (n = 1898)	MetS only by IDF (n = 135)	MetS only by NCEP (n = 776)	MetS by IDF and NCEP (n = 1763)
Congestive heart failure	Yes vs. no	1.365 (1.007-1.850)	1.322 (1.021-1.711)	1.067 (0.568-2.004)	0.955 (0.702-1.298)	1.302 (1.009-1.679)
	p-value	0.0447	0.0341	0.8399	0.7679	0.0422
Angina	Yes vs. no	1.327 (1.089-1.616)	1.326 (1.118-1.574)	0.598 (0.362-0.990)	0.823 (0.667-1.015)	1.415 (1.194-1.677)
	p-value	0.0050	0.0012	0.0455	0.0680	< 0.0001
Myocardial infarction	Yes vs. no	2.039 (1.378-3.016)	0.984 (0.736-1.316)	0.238 (0.058-0.968)	1.613 (1.176-2.212)	1.117 (0.836-1.492)
	p-value	0.0004	0.9137	0.0449	0.0030	0.4557
Prior stroke/ transient ischemic attack	Yes vs. no	1.396 (1.148-1.699)	1.123 (0.951-1.327)	0.697 (0.434-1.118)	1.128 (0.929-1.370)	1.179 (0.999-1.390)
	p-value	0.0009	0.1706	0.1344	0.2239	0.0514
Cardiovascular disease	Yes vs. no	1.395 (1.196-1.627)	1.226 (1.071-1.403)	0.683 (0.476-0.980)	1.002 (0.853-1.177)	1.293 (1.130-1.479)
	p-value	< 0.0001	0.0031	0.0385	0.9811	0.0002

IDF, International Diabetes Federation; NCEP, National Cholesterol Education Program.

Method: logistic regression model.

MetS by NCEP: metabolic syndrome cases meeting NCEP ATP III criteria.

MetS only by IDF: metabolic syndrome cases meeting by IDF criteria.

MetS only by IDF: metabolic syndrome cases only meeting by IDF criteria, but not NCEP ATP III criteria.

MetS only by NCEP: metabolic syndrome cases only meeting by NCEP ATP III criteria, but not IDF criteria.

MetS by IDF and NCEP: metabolic syndrome cases meeting both IDF and NCEP ATP III criteria.

Cardiovascular disease: congestive heart failure, angina, myocardial infarction, or prior stroke/transient ischemic attack.

subjects with MetS based on NCEP criteria.

Those who met the NCEP, but not the IDF criteria ($n = 776$), had a significantly elevated OR for MI (1.61, 95% CI 1.18-2.21). In contrast, those who met the IDF, but not the NCEP criteria ($n = 135$), did not have significantly elevated ORs for any CVD, and even lower ORs for AP, CHF and all CVD.

DISCUSSION

MetS affects about one in five adults in the United States, and 10-20% of the adult Chinese population, with a higher prevalence in persons older than 60 years and in certain ethnic groups.¹³⁻¹⁵ Among an urban Chinese population 30-70 years of age, the previously reported prevalence of MetS was > 26% when Asian criteria for abdominal obesity were applied.¹⁶ Furthermore, in Chinese and Japanese populations, people who have MetS

are 3-10 times more likely to develop CVD.¹⁶⁻¹⁸ Lin et al.¹⁹ reported that MetS was widespread among Taiwanese adults ≥ 40 years of age, and that it has become a serious public health challenge in Taiwan metropolitan areas.

Hypertension is the key component of MetS. A substantial proportion of patients who develop clinically evident hypertension also have insulin resistance. A previous study²⁰ reported that hypertension was linked to MetS through obesity. Indeed, a significantly high prevalence (71.59%) of central obesity was observed in our subjects. However, a recent cross-sectional study of 15,540 Chinese adults 35-74 years of age showed that waist circumference and BMI had independent effects on the odds of hypertension, dyslipidemia, and MetS in both men and women.²¹ Both the seventh report of the Joint National Committee²² and the European Society of Hypertension – European Society of Cardiology Guidelines²³ emphasize the importance of diagnosing MetS

when treating hypertensive patients. The Progetto Iper-tensione Umbria Monitoraggio Ambulatoriale study, which included 1,742 initially untreated hypertensive patients without CVD, recently showed that MetS amplifies the risk associated with high blood pressure, independent of several traditional cardiovascular risk factors. Over a mean follow-up period of 4.1 years, the presence of MetS was a significant independent predictor of both cardiac [hazard ratio (HR) 1.48, 95% CI 1.01-2.27] and cerebrovascular (HR 2.11, 95% CI 1.27-3.50) events.⁵ The adverse prognostic value of MetS was attenuated, but still significant, among hypertensive patients without diabetes.²⁴

Hypertension occurs more frequently in Asian populations than in Caucasian populations.^{10,25} A previous study revealed that nearly all hypertensive subjects (91.3%) have at least one cardiovascular risk factor in addition to the hypertension itself.²⁶ Our study showed a similar result: 94.35% and 90.75% of subjects had at least one component of MetS identified by modified NCEP criteria and revised IDF criteria, respectively. These consistent findings suggest that a multifactorial approach to the treatment of hypertension is very important to reduce the incidence of CVD. In 2005, Hsu et al.²⁷ reported MetS to be highly prevalent (47.9%) in Chinese (Taiwanese) hypertensive patients, but patients in this study were recruited by a single physician from one tertiary referral center, and the patient population was not representative. In our study, a high prevalence of MetS in elderly hypertensive subjects was noted based on both NCEP and IDF criteria (73.13% and 54.67%). The prevalence was higher in women, and the sex differential is primarily attributable to a higher proportion of central obesity in women (81.25%) than in men (62.19%), and a higher proportion of low HDL-C in women (41.15%) than in men (29.59%). These results are consistent with those of the previous report by Hsu et al.²⁷ In addition, central obesity as a prerequisite in the IDF criteria may explain the lower prevalence of MetS.

In April 2006, He et al.²⁴ reported on MetS in 2,334 elderly Chinese people, and showed that subjects with MetS, according to either the IDF or the NCEP criteria, had significantly higher odds of coronary heart disease, stroke, and peripheral arterial disease. Our results showed that subjects with MetS defined by NCEP criteria had high odds of AP, MI, stroke, CHF, and all CVD,

and those who met the IDF or both criteria had high odds of AP, CHF, and all CVDs. Our subjects were all hypertensive patients, which is the main component of MetS. Subjects who met NCEP criteria had significantly higher odds of both cardiac and cerebrovascular diseases.

Participants who met the IDF, but not the NCEP criteria in the previous report²⁴ had significantly elevated ORs for CHD (1.66, 95% CI 1.31-2.10) and stroke (1.53, 95% CI 1.13-2.06). Thus, the authors suggested that the new IDF criteria are more suitable than the NCEP criteria for screening higher-risk individuals, and for estimating the risk of CVD from MetS in the Chinese population.²⁴ However, in our study, the subjects who met the NCEP but not the IDF criteria had significantly elevated ORs for MI, but those who met the IDF but not the NCEP criteria did not have significantly elevated OR for any CVD and even lower ORs for AP, CHF and all CVDs. On the contrary, these results indicated that NCEP criteria more accurately estimated CVD risks and central obesity seems shouldn't be requisite component of MetS in our population. The major differences between our study and the previous report are: (1) our participants were all hypertensive patients; and (2) the subjects in our study included urban and rural populations.

The main strength of our study is that these data are from a representative sample of Taiwanese adults. Therefore, these results can be generalized to the hypertensive population of Taiwan 55–80 years of age. Based on our results, we indicate that NCEP may be better than IDF criteria for screening older hypertensive individuals and estimating the risk of CVD from MetS in the Taiwanese population. The main limitation of our study is that it was a cross-sectional study, and because of missing data on triglycerides, the prevalence of MetS may have been underestimated. Large-scale prospective studies are still needed.

CONCLUSION

MetS is highly prevalent in hypertensive patients 55-80 years of age in Taiwan, particularly among women. Subjects with MetS defined by either criterion have significantly elevated odds of AP, CHF and all CVDs. For estimating the risks of cardiovascular disease, modified NCEP criteria seem to be more suitable

than revised IDF criteria. Programs to enhance efforts aimed at prevention, detection, and treatment of the components of MetS other than hypertension may greatly reduce the future burden of CVD in this population.

CONFLICT OF INTEREST

The authors have no conflicts of interest directly relevant to the contents of this article.

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