

Prevalence of metabolic syndrome in Taiwanese adults: a hospital-based study

Chih-Hsueh Lin, Shih-Wei Lai, Chiu-Shon Liu

The constellation of dyslipidemia (hypertriglyceridemia and a low level of high-density lipoprotein cholesterol), elevated blood pressure, impaired glucose tolerance, and central obesity is identified now as metabolic syndrome, also called syndrome X.^{1,2} People with the syndrome are about twice as likely to develop cerebrovascular disease (CVD) and over four times as likely to develop type 2 diabetes compared with subjects who do not have metabolic syndrome.³ While this syndrome may have a genetic basis,^{4,5} environmental factors are important modifiable risk factors for the condition. In Chuang's report from Taiwan, the prevalence of metabolic syndrome was 9.5% (10.6% in men and 8.1% in women) based on the strict NCEP III criteria, and 12.9% (15.5% in men and 10.5% in women, respectively) by the Asian criteria for waist circumference.⁶ To further assess the prevalence of metabolic syndrome in Taiwan, we gathered and analyzed data on all adults who came to the China Medical University Hospital in Taichung for preventive services from January to December in 2004.

Patients and Methods

In a cross-sectional hospital-based study, we analyzed the health status of adults who voluntarily visited one medical center located at Taichung city from January to December 2004. All individuals aged 18 to 84 were candidates. They visited the center for preventive services, which included a self-administrated questionnaire, history taking, physical examination (including waist circumference), and measurement of fasting blood biochemistry. Blood pressure was measured in the sitting position by a mercury sphygmomanometer. Blood samples were obtained in the morning after a 12-hour overnight fast. A number of biochemical markers, such as high-density lipoprotein cholesterol (HDL-C), triglyceride, and fasting glucose were analyzed by a biochemical auto-analyser within 4 hours after collecting the samples (Hitachi 736-15, Tokyo, Japan) at the Department of Clinical Laboratory of this medical center.

The metabolic syndrome was defined 3 or more of the following conditions: 1) hypertension, defined as a history of hypertension or a blood pressure greater than or equal to 130/85 mm Hg; 2) hyperglycemia, defined as a history of diabetes or a fasting plasma glucose greater than or equal to 110 mg/dL; 3) hypertriglyceridemia, defined as fasting triglycerides greater than or equal to 150 mg/dL; 4) a low HDL-C, defined as a fasting HDL-C less than 40 mg/dL in men or less than 50 mg/dL in women, and 5) central obesity, defined as a waist circumference greater than 90 centimeters in men or greater than 80 centimeters in women (Asian WHO criteria).^{7,8}

Statistical analysis was performed with the SPSS package (Chinese Version 10.0, Sinter Information Corp, Taiwan). The *t* test, chi-square analysis and multivariate logistic regression were used for statistical

From the Department of Family Medicine, China Medical University Hospital, Taichung, Taiwan

Correspondence:
Shih-Wei Lai
Department of Family Medicine
China Medical University Hospital
No. 2
Yuh-Der Road
Taichung, Taiwan
Tel: +886-4-2206-2121
ext 7206
Fax: +886-4-2203-3986
wei@www.cmuh.org.tw

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Table 1. Prevalence of the components of metabolic syndrome.

	Men (%)	Women (%)	P value*	Total
No component	216 (22.7%)	212 (29.2%)	0.003	428 (25.5%)
One component	235 (24.7%)	210 (29.0%)	0.054	445 (26.5%)
Two components	216 (22.7%)	137 (18.9%)	0.069	353 (21.0%)
Three components	163 (17.1%)	98 (13.5%)	0.052	261 (15.6%)
Four components	89 (9.3%)	52 (7.2%)	0.139	141 (8.4%)
Five components	34 (3.6%)	16 (2.2%)	0.139	50 (3.0%)
Metabolic syndrome	286 (30.0%)	166 (22.9%)	0.001	452 (26.9%)

*Men vs. women (chi-square analysis)

analysis. A *P* value less than 0.05 was considered statistically significant.

Results

There were 953 (56.8%) men and 725 (43.2%) women (total, 1678) in this cross-sectional study. The mean age was 49.6 ± 12.3 years (age range, 18–84 years). The prevalence of metabolic syndrome was 30.0% in men and 22.9% in women (Table 1), with significant differences between men and women ($P=0.001$). After controlling for the other covariates, age was positively associated with metabolic syndrome in the multivariate logistic regression (Table 2). That is, a change in age by one year would increase the likelihood of metabolic syndrome (odds ratio=1.06, 95% confidence interval=1.04–1.07, $P<0.0001$). Men were also more likely to have metabolic syndrome than women (odds ratio=1.50, 95% confidence interval=1.19–1.89, $P<0.001$).

Discussion

The prevalence of the metabolic syndrome is increasing owing to lifestyle changes leading to obesity. This syndrome is a complex association of several interrelated abnormalities that increase the risk for cardiovascular disease and progression to diabetes mellitus. Insulin resistance is the key factor for the clustering of risk factors characterizing the metabolic syndrome. The National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III defined the criteria for the diagnosis of the metabolic syndrome and established the basic principles for its management.⁷

This syndrome has become increasingly common in Taiwan. In Chuang's hospital-based study, the prevalence of metabolic syndrome was 9.5% (10.6% in men and 8.1% in women) based on the strict NCEP III criteria, or 12.9% (15.5% in men

and 10.5% in women, respectively) with the Asian criteria for waist circumference.⁶ In our hospital-based study, the prevalence of metabolic syndrome was 30.0% in men and 22.9% in women. The prevalence in our study was higher than that in Chuang's study. Our findings are also higher than those reported from the study population of Kinmen (21.2%),⁹ where the metabolic syndrome was present in 17.7% of men and 23.8% of women in Kinmen.⁹ The prevalence rate of the metabolic syndrome varies among ethnicities and countries.¹⁰

Our study also found that the prevalence of metabolic syndrome increased with age and gender, which is consistent with the study of Chuang's.⁶ A gender difference in metabolic syndrome prevalence rates can be observed in most ethnicities and countries. In American whites and in Taiwan, the metabolic syndrome was slightly more prevalent in men than in women.¹⁰ The mechanistic connections between insulin resistance and metabolic risk factors are not fully understood and appear to be complex. Various risk factors have been included in the metabolic syndrome: abdominal obesity, dyslipidemia, raised blood pressure, insulin resistance, a prothrombotic state, and a proinflammatory state,¹¹ although some components of the metabolic syndrome (insulin resistance, proinflammatory state, and prothrombotic state) cannot be identified by routine clinical evalua-

Table 2. Multivariate logistic regression for metabolic syndrome.

Variable	EP (SE)	OR	95% CI
Intercept	-3.99(0.28)		
Age (years)	0.05(0.01)	1.06	1.04-1.07**
Men (women as reference)	0.41 (0.12)	1.50	1.19-1.89*

EP: estimated parameter; SE: standard error; OR: odds ratio; CI: confidence interval

* $P<0.001$, ** $P<0.0001$

tion. Undoubtedly, it is particularly important to determine other metabolic disorders if one metabolic disorder is detected.

In conclusion, several issues related to metabolic syndrome are unresolved and need further study, but metabolic syndrome is more common in Taiwanese adults than in other countries and is significantly associated with age and gender. We suggest that measuring metabolic syndrome components is necessary for the early detection of this abnormal condition and early intervention. Immediate treatment of the metabolic syndrome is essential because

these patients quickly develop diabetes, cardiovascular disease, and stroke.³ Treatment is multifactorial and includes diet, exercise, and pharmacologic therapy.^{7,12} Although our volunteers were not representative of Taiwanese adults and the sample size was small, we hope that this study provides basic information for further studies on the epidemiology of metabolic syndrome in Taiwanese adults. Therefore, establishment of the benefit and cost-effectiveness of a specific goal for drug therapies directed toward the metabolic syndrome as a whole or particular risk components is clearly needed.

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