

## Clinical Research

## Prevalence of metabolic syndrome in adults in Khanh Hoa, Viet Nam

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**Background** The metabolic syndrome (MS) is characterized by a specific clustering of risk factors, including dyslipidemia, central adiposity, systemic hypertension, insulin resistance, and dysglycemia. It is associated with an increased risk of developing cardiovascular disease (CVD). Accurate data on prevalence and characteristics of MS will facilitate the development of preventive strategies for CVD. **Objective** To estimate accurately the prevalence of MS among Vietnamese adults with the usual criteria or with the criteria modified for Asian populations. **Design and methods** We studied a representative, cross-sectional, population-based sample of 856 subjects (mean age  $52.82 \pm 16.36$ ) classified in three age groups from 15-34 years, 35-54 years and > 54 years of age, living in Khanh Hoa Province, Viet Nam. MS was diagnosed according to the criteria defined by the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (NCEP-ATP III) and by the modified criteria for some Asian populations in which the waist circumference (WC) is considered abnormal if it is > 90 cm for males and > 80 cm for females. **Results** Using the NCEP-ATP III criteria, the prevalence of MS in the studied population was 10.0% (CI 95% : 8.1-12.3). It was 2.4 % in the 15-34 age group (men 4.5% and women 1.2%), 5.2% (men 6.3%, women 4.5%) in 35-54 age group and 15.8% (men 9.7%, women 21.7%) in over 54 age group, respectively. And it was more common in women than in men (11.7% vs 8.0%,  $P < 0.001$ ). Using 2001 population census data of the whole province over 15 years (695 218 habitants) we estimated that about 35 193 people suffered from the MS. The WC was the least common feature of MS (2.1% for men and in 6.1% for women). Overall, 45.2% of the studied population had one feature of MS, 23.1% had two features, 8.2% had three features, 1.6% had four features, and 0.2% had all five features. No feature of MS was identified in 21.7%. Using the modified criteria, the prevalence of MS in the studied population was 15.7%. It was 4.0% in the 15-34 age group, 12.5% in the 35-54 age group and 21.5% in the > 54 age group. Prevalence of modified WC feature was 10.9% for men and 23.6% for women. **Conclusions** MS is more accurately identified among Vietnamese adults using the modified criterion of the WC for some Asian populations. Its prevalence is similar to that in the developed countries. (*J Geriatr Cardiol* 2004;1(2):95-100.)

**Key Words** metabolic syndrome; epidemiology; cardiovascular disease

### Introduction

Cardiovascular disease is the most common cause of mortality and morbidity not only in the developed countries but also in the developing countries.<sup>1</sup> According to the latest report of the World Health Organization (WHO), heart disease is the world's number one killer. Eighty percent of the 17 million deaths caused by heart disease worldwide occur in low and middle-income countries.<sup>1</sup> Traditional major risk factors linking cardiovascular

diseases are hypertension, dyslipidemia, cigarette smoking, diabetes mellitus, age and family history of cardiovascular diseases (CVD). The other confirmed risk factors include obesity, fibrinogen, prior events, renal disease, impaired glucose tolerance, alcohol abuse, lack of physical activity, low socio-economic status, hyperhomocysteinemia, ethnicity and geographical region.<sup>2-10</sup> In recent years, one of the hot topics of cardiology and endocrinology is the metabolic syndrome (MS) which is characterized by a specific clustering of risk factors, including dyslipidemia, central adiposity, systemic hypertension, insulin resistance, and

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dysglycemia. It is associated with increased risk of developing CVD.<sup>5-9</sup> People with the syndrome are about twice (to three fold) as likely to develop CVD and over 4 times as likely to develop type 2 diabetes compared with subjects who do not have MS.<sup>11</sup> Accurate data on prevalence and characteristics of MS will facilitate the development of preventive strategies for CVD. In the United States, national survey data suggest MS is very common, affecting about 24% of US adults who are 20 to 70 years of age and older.<sup>5,6</sup> In European countries, the prevalence of MS in men > 55 years was from 19% to 46%, and in women was from 17% to 30%.<sup>6</sup> In the Asian Pacific region, the prevalence of MS ranged from 11% to 35%; in India 23%, Israel 15%, Iran 33%, and Indonesia 17%.<sup>12-15</sup> Some of the differences are probably attributed to differences in definition, methodology, demographic composition and socio-economic circumstances. In Viet Nam, the prevalence of hypertension is 10-23%; diabetes mellitus 4-7%, dyslipidemia 21-40%, however, the data on the prevalence of MS is deficient.<sup>16-19</sup> Therefore, we conducted this study to have an accurate estimate of the prevalence of MS among Vietnamese adults using the conventional criteria or the criteria modified for Asian populations.

## Subjects and methods

### Subjects and study design

Based on the result of the previous survey,<sup>18</sup> a representative, cross-sectional, population-based sample consisted of 1 071 subjects classified in three age groups from 15-34 years, 35-54 years and > 54 years of age, living in Khanh Hoa Province, Viet Nam. Khanh Hoa, a province with about 1 071 062 people, located in central Viet Nam. This population sample represents both the rural and urban population and was randomly chosen at 10 communes out of a total of 127 communes in the province according the ratio distribution of its population. Among them, 856 subjects were recruited (mean age  $52.82 \pm 16.36$ ) for this study and 215 subjects were excluded by incomplete data collection or missing for screening or history of antilipidemic medication or other drugs interfering with lipid metabolism, significant hepatic, renal or thyroid dysfunction and/or acute or chronic inflammatory diseases. The survey was conducted between January 2002 and September 2003. All the study subjects were ethnic Vietnamese. The educational levels of the participants were primary school (51.4%), high school (30.3%), and college/university graduates (6.7%). Among them, 32% were farmers, 3.8% were fishermen, 14% were employed, 25% were in private business,

9.11% were retirees, 11% were unemployed, and 20.10% have health insurance.

### Medical history and clinical examination

All participants were evaluated by trained physicians for cardiovascular risk factors by answering a standardized questionnaire and undergoing a complete physical examination. Body weight and height were recorded. Body mass index (BMI) was computed as weight divided by height squared. WC was measured at the level of the umbilicus. Blood pressure (BP) was measured twice at rest by a physician or a trained nurse with a standard mercury sphygmomanometer, with the patient sitting and his/her arm supported at heart level.

### Serum lipid and glucose analysis

Fasting venous blood samples were obtained between 7 and 9 am and put into vacutainer tubes from all study participants and analyzed for total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglyceride and glucose by enzymatic spectrophotometric technique. All blood lipid analyses were done at laboratories of Nha Trang Pasteur Institute using an ALLYON 300 instrument (Abbott, USA). Serum LDL-C was calculated with the equation of Friedewald et al, except when triglycerides exceeded 400 mg/dl (10.04 mmol/L) (in such case LDL-C was directly assessed). In the first screening, if the participants were found to have any feature of MS, they would be screened again for that feature and mean values after two screenings were determined for the diagnosis of MS.

### Definition of the metabolic syndrome

MS was diagnosed according to the criteria defined by the NCEP-ATP III ( $\geq 3$  of the following abnormalities): WC > 102 cm in men and 88 cm in women; serum triglycerides level of at least 150 mg/dl (1.69 mmol/L); HDL-C level of less than 40 mg/dl (1.04 mmol/L) in men and 50 mg/dl (1.29 mmol/L) in women; blood pressure of at least 130/85 mmHg; or serum glucose level of at least 110 mg/dl (6.1 mmol/L)<sup>9,10</sup> and by the modified criteria for some Asian populations in which the WC is considered abnormal if it is > 90 cm for men and > 80 cm for women.

### Statistical analysis

Data are presented as frequencies, percentages, and 95% confidence intervals, and were expressed as mean  $\pm$  SD. Differences between the two sexes were assessed by Student's *t* test for continuous variables. *Chi-square* was used to compare categorical variables. The age-



specific distributions of the MS of the studied population were calculated separately for men and women and between the age groups. Value of  $P < 0.05$  was considered statistically significant. Data were analyzed with SPSS.

### Results

The baseline characteristics of the studied population are presented in Table 1.

The prevalence of MS with the standard criteria of ATP III in the studied population was 10.0% (CI 95% : 8.1-12.3). As shown in Fig. 1, this prevalence increased with age in both men and women. The prevalence of MS in the 15-34 age group was 2.4% (men 4.5% and women 1.2%); in 35-54 age group

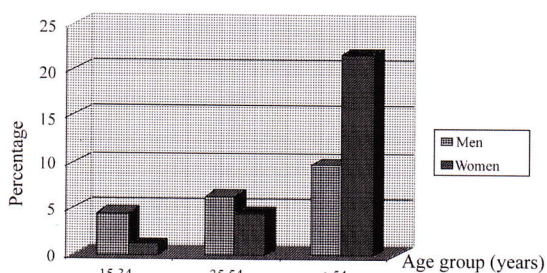


Fig. 1. Age-specific prevalence of metabolic syndrome by sex in adult population at Khanh Hoa in Viet Nam

was 5.2% (men 6.3%, women 4.5%), and in over 54 age group was 15.8% (men 9.7%, women 21.7%).

Women had a higher prevalence than men (11.7% vs 8.0%,  $P < 0.001$ ). Using 2001 population census data of the whole province over 15 years (695 218 habitants) with the mean age  $33.7 \pm 16.8$ , it was estimated about 35 193 people having MS.

Using the modified criterion of WC, the prevalence of MS in the studied population was 15.7% (CI 95% : 13.4-18.4) (men 13.5%, women 17.3%). In the 15-34 age group was 4.0% (men 4.6%, women 3.6%); 45-54 age group, 12.5% (men 15.1%, women 10.6%) and over 54 age group, 21.5% (men 14.5%, women 29.1%), respectively. WC was the least common feature of MS (2.1% for men and 6.1% for women). This is the characteristic which leads to a false low prevalence when the criteria of ATP III were applied in some Asian populations. However, if using the modified criterion of WC, the frequency of this feature was 10.9% in men and 23.6% in women. Both WC and HDL-C cut-off points were more significantly prevalent in women than in men.

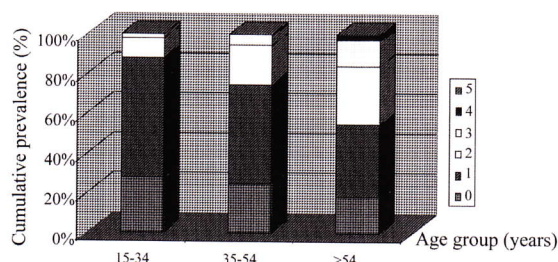


Fig. 2. Cumulative age-specific prevalence of metabolic abnormalities in adult population at Khanh Hoa in Viet Nam

Table 1. Some baseline characteristics of the studied population

Characteristic	Total (n = 856)	Men (n = 377)	Women (n = 479)	P value*
Age	52.8(16.3)	54.0(16.0)	51.9(16.7)	NS
Smoking	33.6(3.1)	65.8(5.1)	8.2(2.2)	0.0001
Weight (P, kg)	50.5(9.5)	53.7(9.7)	48.0(8.40)	0.001
Height (T, m)	1.55(0.08)	1.6(0.08)	1.5(0.07)	0.001
BMI(P/T <sup>2</sup> )	21.0(3.5)	21.0(3.6)	21.0(3.4)	NS
Waist(mm)	75.0(10)	76.6(9.9)	72.8(7.7)	0.001
Hip(mm)	88.9(8.0)	89.4(7.7)	88.6(8.3)	NS
Waist/Hip ratio	0.83(0.09)	0.86(0.07)	0.82(0.09)	0.001
SBP(mmHg)	127.3(24.4)	132.2(24.0)	123.4(24.0)	0.001
DBP(mmHg)	78.5(12.9)	80.8(12.5)	76.7(13.0)	0.001
FPG(mg/dl)	101.0(34.3)	101.4(31.0)	100.6(36.2)	NS
TC(mg/dl)	198.9(43.7)	195.9(45.0)	201.3(42.3)	NS
LDL-C(mg/dl)	120.9(36.6)	117.2(36.5)	123.9(36.5)	0.01
HDL-C(mg/dl)	46.1(4.4)	46.4(3.3)	46.8(5.2)	NS
TRI(mg/dl)	133.3(86.4)	144.4(102.1)	124.6(70.5)	0.001
Number of mean features	1.2(0.9)	1.1(0.9)	1.3(0.9)	0.001

SBP = systolic blood pressure; DBP = diastolic blood pressure; FPG = fasting plasma glucose; TC = total cholesterol; TRI = triglyceride; NS = no significance, \*t test for equality of means

**Table 2. Age standardized prevalence of individual features of MS in Khanh Hoa's adult population (% , CI 95%)**

	No. of participants	Abdominal obesity (%)	Modified abdominal obesity (%)	Hypertriglyceridemia (%)	Low HDL-C (%)	High blood pressure (%)	High fasting plasma glucose (%)
Total	856	4.3(3.1-5.9)	18.0(15.5-20.8)	27.3 (24.4-30.4)	37.1 (33.9-40.5)	34.5 (31.3-37.8)	19.4 (16.8-22.2)
Male	377	2.1(1.0-4.3)	10.9(8.0-14.6)	31.3 (26.7-36.3)	17.0 (13.4-21.3)	40.8 (37.5-44.2)	21.8 (17.8-26.4)
Female	479	6.1(4.2-8.7)	23.6(19.9-27.7)	24.2 (20.5-28.3)	52.8 (48.2-57.3)	29.4 (25.4-33.7)	17.5 (14.3-21.3)
15-34	127	4.7(1.9-10.4)	9.4(5.2-16.2)	15.0 (9.5-22.7)	59.1 (50.0-67.6)	4.7 (1.9-10.4)	4.7 (1.9-10.7)
35-54	305	2.3(1.0-4.9)	17.4(13.4-22.2)	24.9 (20.2-30.2)	42.6 (37.0-48.4)	21.3 (16.9-26.4)	13.8 (10.2-18.3)
> 54	424	5.7(3.8-8.5)	21.0(17.3-25.3)	32.8 (28.4-37.5)	26.7 (22.6-31.2)	52.8 (47.9-57.6)	27.8 (23.6-32.4)

**Table 3. Age-standardized cumulative prevalence of standard features of MS including abdominal obesity, hypertriglyceridemia, low HDL-C, high blood pressure, and high fasting plasma glucose in adult population at Khanh Hoa in Viet Nam**

Age group	Number of features (% , CI 95%)					
	0	1	2	3	4	5
Total	21.7(19.0-24.6)	45.2(41.8-48.6)	23.1(20.3-26.1)	8.2(6.5-11.3)	1.6(0.9-2.7)	0.2 (0.03-0.9)
Male	34.2(29.5-39.3)	39.0(34.1-44.1)	20.4(16.5-24.9)	5.6(3.6-8.6)	0.8 (0.2-2.5)	0
Female	15.0(12.0-18.6)	50.7(46.1-55.2)	22.6(19.0-26.7)	9.0(6.7-12.0)	2.3(1.2-4.2)	0.4(0.07-1.6)
15-34	27.6(20.2-36.4)	60.6(51.5-69.0)	9.4(5.2-16.2)	2.4(0.6-7.3)	0	0
35-54	24.9(20.2-30.2)	49.8(44.0-55.5)	20.0(15.7-25.0)	4.6(2.6-7.8)	0.7(0.1-2.7)	0
> 54	17.7(14.2-21.7)	37.3(32.7-42.1)	29.2(25.0-33.8)	12.5(9.6-16.1)	2.8(1.5-5.0)	0.5(0.09-1.8)

The other features were more common in men than in women ( $P < 0.001$ , Table 2). The prevalence of MS features was shown in Table 3. Overall, 45.2% of the studied population had one MS feature, 23.1% had two features, 8.2% had three features, 1.6% had four features, and 0.2% had all five features. No MS features were identified in 21.7% of the studied population.

### Discussion

Metabolic syndrome is strongly related to central obesity and associated with a high risk of cardiovascular morbidity and mortality.<sup>20-26</sup> Since its original description by Reaven in 1988, several working definitions have been proposed, especially by the WHO in 1998-99, the NCEP-ATP III in the United States in 2001 and the European Group for the Study of Insulin Resistance (EGIR) in 2002.<sup>7,8,20</sup> Until now, although there are differences in guidelines on cardiovascular disease prevention in clinical practice between the United States and Europe, the criteria of MS defined by NCEP-ATP III were accepted in both of them.<sup>9,10</sup> Therefore, we used

these criteria for our study. However, there will be a false prevalence of MS for some Asian populations if all of features of MS in NCEP-ATP III are applied for them because these populations have their own special characteristics compared with the other continents.<sup>27</sup>

According to DCH Wai and co-workers' study in Singapore using NCEP-ATP III cut-off of WC of 102 cm and 88 cm for men and women, the sensitivity was only 8.4 to 12.2% in predicting the presence of any of the MS features for men, and 21.7 to 33.8% for women.<sup>28-35</sup> We noted that the WC of 2.1% for men and of 6.1% for women was the least common feature of MS. According to the criteria of Asians of the Regional Office for the Western Pacific Region of WHO criteria pertaining to obesity (WPRO 2000), a WC of > 90 cm for men and of > 80 cm for women may be obese for Asian-Pacific populations.<sup>36</sup> Therefore, we used these levels for the modified criterion of WC in NCEP-ATP III for MS. Our previous study showed the frequency of multiple risk factors in our local population was not largely different from that of the developed countries,<sup>19</sup> hence, with the modified criterion of WC we had the prevalence of MS



similar to those in the developed countries such as 16% in France, 17% in Italy, 21% in USA.<sup>5,6,20,31</sup> In some Asian countries such as Indonesia, Singapore and Japan, the prevalences of MS using the modified criteria are also similar to ours.<sup>13,14,27</sup> In contrast, in South Asia and Middle East countries such as India, Iran and Kuwait they range 18-34% using the standard criteria of NCEP-ATP III.<sup>12,15,29</sup> For this reason, the modified criterion of WC in MS is only necessary in some Asian populations but it is not representative for the whole Asian populations. According to the latest WHO expert consultation notes, some Asian populations have an increased proportion of body fat compared with white people of the same age, sex and BMI. In addition, there is increasing evidence of high prevalence of type 2 diabetes and increased cardiovascular risk factors in parts of Asia where the average BMI is below the cut-off point of 25 kg/m<sup>2</sup>. The consultation also notes that in populations with a predisposition to central obesity, WC may be an important additional factor to take into account when risk is assessed.<sup>36</sup>

All of these evidence leading to the modified criterion of WC for MS for some Asian populations are logical and will facilitate the development of preventive strategies of CVD. The prevalence of MS was noted to be significantly higher among women than men and similar to the studies in some Asian populations. In contrast, in the developed countries such as USA, there is no difference between men and women,<sup>5</sup> while in European countries, men with MS are much more frequently seen than women for all age groups.<sup>7</sup> These may be due to the difference between the rates of WC to HDL-C cut-off points in some Asian populations, in which they are higher in women compared with men. In some Asian countries, women generally have less physical activity, and overweight and obesity are common among them.<sup>36,37</sup> In addition, the frequency of the feature of the low HDL-C was highest in this study (37.1% including 17.0% for men and 52.8% for women), which is similar to some Asian populations such as Iranian (73%) and Indonesian (36%).<sup>15,16</sup> This is also a characteristic which is different from the western populations.

In this study, the mean HDL-C level between women and men is not different. In contrast, in the USA, HDL-C level of < 40 mg/dl was 30-40% for men and 15% for women.<sup>5</sup> Therefore, does HDL-C cut-off point need to be modified for the diagnosis of MS for some Asian populations? A modification of HDL-C threshold from < 50 mg/dl to < 45 mg/dl for women is necessary? Further study is needed to answer these questions in the future to confirm more accurately the prevalence of MS in

Asia. The prevalence of MS is increased with age in both sexes, and the frequency of each MS feature was also increased with age, except HDL-C. Ford and other authors have also shown an effect of age on the prevalence of MS.<sup>5,37</sup> The frequency of high blood pressure  $\geq$  130/85 mmHg was 34%, similar to that in the developed countries as well as in some Asian countries. Reaven and co-workers indicated that about half of the patients with hypertension could have insulin resistance and hyperinsulinemia.<sup>15</sup> There is a significant correlation between blood pressure and fasting serum insulin level, further supporting the role of insulin resistance in the pathogenesis of essential hypertension.<sup>15-30</sup> However, the latest guidelines from JNC VII, ESC/ESH I to the updated 2003 WHO/ISH statement on the management of hypertension, the treatment of high blood pressure for the MS has not yet received an attention appropriately.<sup>2-4</sup>

In this study, the frequency of hypertriglyceridemia (27.3%) was lower than that of some populations such as Iranians (46%), Americans and Indonesians.<sup>5,6,14,15</sup> The frequency of high fasting plasma glucose of our studied population is similar to that of the developed countries. The elevated fasting plasma glucose is a character linked to insulin and hyperinsulinemia, in which the features of MS have been associated with increased risk of chronic complications in type 2 diabetes. Thus, the treatment of hyperglycemia for the diabetics with MS must be of priority. Overall, only 21.7% in the studied population had not any MS feature, 45.2% had  $\geq$  one feature of MS. Therefore, we need strong strategy for the prevention of CVD, in which focus should be on the change of lifestyle and exercise along with the control of all risk factors, especially metabolic abnormalities of MS.

## Conclusions

MS is more accurately identified among Vietnamese adults using the modified criterion of the WC for Asian Western Pacific populations. Further studies are needed to confirm appropriately the modification of WC and HDL-C cut-off points for these populations. Strong strategies for the screening of MS and modification of their abnormalities both in public healthcare and in daily clinical practice are also urgently needed.

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