Clinical Research

A new formula for screening metabolic syndrome in Asians:
skin fold thickness at A8 point on Erdheim diagram and waist circumference

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Background and objectives Recent studies have shown that abdominal obesity is an important component for the diagnosis of metabolic syndrome (MS) and MS is a high risk factor for cardiovascular disease and diabetes mellitus. The aim of this study was to develop a new formula for screening and diagnosis of MS using the waist circumference (WC) and skin fold thickness at the point A8 (SFAs) on the Erdheim diagram. Methods A total of 358 essential hypertensive patients (189 male and 169 female) with a mean age of 59.0±9.7 years were included; 151 healthy people (79 male, 72 female) with a mean age of 57.3±12.1 years (similar to hypertensive patients) who were non-hypertensive and non-diabetic served as a control group. All subjects had no evidence of hepatic, renal, or endocrine disease as determined by history, physical examination and screening blood tests. Height, weight, WC, SFAs, blood pressure (BP), fasting plasma glucose, HDL-cholesterol and triglyceride levels were measured in all subjects. Abdominal obesity measured by WC using the Asia-Pacific criteria (IDFA) was applied for meeting the MS definition. The normal value of SFAs was measured in the non-MS group. Relationships between SFAs and systolic BP, diastolic BP, fasting plasma glucose, HDL-cholesterol and triglyceride levels were calculated in the control group. A new formula was developed according to high SFAs and high WC. Results The normal value of SFAs in non-MS group was 23.2±7.2 mm in male and 26.5±6.6 mm in female, respectively. The value of SFAs in MS group was 36.7±7.4 mm in male and 38.1±8.1 mm in female, respectively. The value of WC in MS group and non-MS group were 92.5±3.0 cm and 79.4±6.1 cm in male and 86.3±6.4 cm and 74.7±5.4 cm in female, respectively. There was a correlation between SFAs and systolic BP, diastolic BP, fasting plasma glucose, HDL-cholesterol and triglyceride in control group (the correlation coefficients were 0.29, 0.23, 0.25, -0.31 and 0.46, respectively, P<0.01). A new formula for MS was suggested as high WC (≥90 cm in male, ≥80 cm in female) + high SFAs (≥30 mm). The sensitivity, specificity, false positive rate, false negative rate, positive predictive value, and negative predictive value of the new formula assessed with the IDFA definition were 94%, 93%, 7%, 6%, 92% and 95%, respectively. The percentage of all patients who met the criteria for MS by conventional definition was 46.2%. The percentage of all patients who met the criteria by the new definition was 47.0%. There was no difference between the prevalence percentage of the MS according to new criteria and the IDFA criteria in all patients, in male and in female, respectively (P>0.05). Conclusion This new formula for MS might be useful for easy screening. The advantage over current criteria is the lack of need for laboratory testing. (J Geriatr Cardiol 2007;4:32-41.)

Key Words waist circumference; skin fold thickness; metabolic syndrome

Introduction

There is a growing burden of non-communicable diseases (NCDs) all over the world.1-5 In particular, cardiovascular diseases (CVDs) and diabetes mellitus (DM) have become the major causes of death and disability in many countries.2,23 Most studies have shown that the metabolic syndrome (MS) is a high risk factor for CVD and DM that results from increasing prevalence of abdominal obesity in worldwide populations.1,20 The World Health Organization (WHO) and several formal guideline papers have proposed the MS as a clustering of components such as obesity, abdominal fat, glucose intolerance (DM, impaired fasting glucose and impaired glucose tolerance), dyslipidemia, insulin resistance and hypertension.31-35 A few authors have proposed adding certain biomarkers such as C-reactive protein to the diagnosis of MS.46-47 Therefore, to diagnose the MS, a laboratory evaluation to measure fasting glucose, lipids, insulin concentrations and other biomarkers are necessary. Most studies have implicated that the diagnosis of the MS is helpful to prevent CVD, DM and deaths from
rising in the future. However, it is difficult to screen for MS in large populations. Several studies have shown that visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT) are strongly correlated with insulin resistance and MS (Table 1). Both VAT and SAT can be estimated by waist circumference (WC) and skin fold thickness (SF). Despite the fact that WC has become a component of the MS in most definitions, the diagnosis of MS depends on fasting glucose and fasting lipid values as in the International Diabetes Federation (IDF) definition. The SAT has been closely correlated with insulin resistance and can be estimated from SF at A8 point on Erdheim diagram (SFA8). In addition, previous studies have reported that the SAT correlated with adiponectin and leptin values better than VAT. Laboratory criteria make it difficult to diagnose MS for a large population, particularly in low- and middle-income regions. The aim of this study was to develop a new formula for screening and diagnosis of MS according to a simple anthropometrics using the WC and the SFA8.

Methods

Subjects

The present study was done on 509 subjects, who were admitted from January 2005 to September 2006 in hospital 103, Ha Dong and in hospital 108, Ha Noi, Vietnam. There were 358 essential hypertensive patients (hypertension group; male 189, female 169, mean age of 59.0±9.7 years) and 151 healthy people (control group; 79 male, 72 female, mean age of 57.3±12.1 years) who were non-hypertensive and non-diabetic. All subjects had no evidence of hepatic, renal, or endocrine disease as determined by history, physical examination and screening blood test.

Blood pressure measurements

Blood pressure was measured in the left arm. The onset of the first Korotkoff phase was used to determine the systolic blood pressure (SBP) and onset of the fifth Korotkoff phase was used to determine the diastolic blood pressure (DBP). Blood pressure measurements were taken three times. Then, the average of the 3 measurements was used in the analysis. SBP ≥ 140 mmHg and/or the DBP ≥ 90 mmHg was defined as hypertension.

Anthropometric measurements

Body weight was measured in light clothing without shoes and with an empty bladder. Height was measured as the distance from the top of head to bottom of the feet (without shoes) using fixed stadiometer. The average of two measurements was used to calculate BMI (weight/square of the height). The WC and hip circumference was measured, using a flexible tape with a tension caliper at the extremitity as the point midway between the costal margin and iliac crest in the mid-axillary line with the subjects standing and breathing normally and at the widest point around the greater trochanter. The average of two measurements was used for calculation. According to WHO guidelines for abdominal obesity as defined by Asia-Pacific criteria, the patients were classified as overweight and obese.

Table 1. Correlation coefficients (r) between insulin-mediated glucose and body fat distribution

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Population</th>
<th>VAT (cm²)</th>
<th>SAT (cm²)</th>
<th>Total fat (cm²)</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abate N</td>
<td>1995</td>
<td>39 men</td>
<td>-0.51</td>
<td>-0.62</td>
<td>-0.61</td>
<td></td>
</tr>
<tr>
<td>Cafalu WT</td>
<td>1995</td>
<td>60 subjects</td>
<td>-0.50</td>
<td>-0.50</td>
<td>-0.57</td>
<td></td>
</tr>
<tr>
<td>Goodpaster BH</td>
<td>1997</td>
<td>54 subjects</td>
<td>-0.52</td>
<td>-0.61</td>
<td>-0.58</td>
<td></td>
</tr>
<tr>
<td>Banerji MA</td>
<td>1999</td>
<td>20 South Asian men</td>
<td>-0.59</td>
<td>-0.54</td>
<td>-0.56</td>
<td></td>
</tr>
<tr>
<td>Kelley DE</td>
<td>2000</td>
<td>47 men</td>
<td>-0.61</td>
<td>-0.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tai ES</td>
<td>2000</td>
<td>21 women</td>
<td>-0.33</td>
<td>-0.57</td>
<td>-0.71</td>
<td>-0.53</td>
</tr>
<tr>
<td>Sites CK</td>
<td>2000</td>
<td>27 postmenopausal women</td>
<td>-0.39</td>
<td>-0.43</td>
<td>-0.30</td>
<td></td>
</tr>
<tr>
<td>Goran MI</td>
<td>2001</td>
<td>68 white children</td>
<td>-0.59</td>
<td>-0.70</td>
<td>-0.68</td>
<td></td>
</tr>
<tr>
<td>Rendell M</td>
<td>2001</td>
<td>51 African American children</td>
<td>-0.43</td>
<td>-0.47</td>
<td>-0.52</td>
<td></td>
</tr>
<tr>
<td>Raij A</td>
<td>2001</td>
<td>24 subjects</td>
<td>-0.55</td>
<td>-0.47</td>
<td>-0.61</td>
<td>-0.61</td>
</tr>
<tr>
<td>Cnop M</td>
<td>2002</td>
<td>174 subjects</td>
<td>-0.69</td>
<td>-0.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruz ML</td>
<td>2002</td>
<td>32 Hispanic children</td>
<td>-0.44</td>
<td>-0.46</td>
<td>-0.46</td>
<td></td>
</tr>
<tr>
<td>Laaksonen DE</td>
<td>2003</td>
<td>Obese men and women</td>
<td>-0.57</td>
<td>-0.57</td>
<td>-0.57</td>
<td></td>
</tr>
<tr>
<td>Tulloch-Reid MK</td>
<td>2004</td>
<td>44 African American men</td>
<td>-0.57</td>
<td>-0.57</td>
<td>-0.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>34 African American women</td>
<td>-0.50</td>
<td>-0.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
and having abdominal obesity when they had BMI $\geq 23$ kg/m$^2$ or WC $\geq 90$ cm in male, $\geq 80$ cm in female.

The skin fold thickness at the SFA8 points (near navel, horizontal and vertical) were measured on the abdomen on the Erdheim diagram by an Accu-Measure caliper. The mean of three consecutive measurements at each site and the mean of the measurement of SF on the left and on the right were selected.

**Fasting plasma glucose and fasting plasma lipids measurements**

Venous blood was drawn from the subjects after 12 hours fast. Fasting glucose, high-density lipoprotein (HDL) cholesterol and triglycerides (TG) were measured according to the enzyme methods of the Department of Biochemistry in the Hospital 103 and Hospital 108.

**Definitions of metabolic syndrome**

The MS was diagnosed by the Asia-Pacific criteria (IDFA) as central obesity (defined as WC $\geq 90$ cm in male, $\geq 80$ cm in female) plus any two of the following four abnormalities:

- Increased TG levels ($\geq 1.7$ mmol/L), or specific treatment for this lipid abnormality.
- Increased BP (SBP $\geq 130$ mmHg and/or DBP $\geq 85$ mmHg), or treatment of previously diagnosed hypertension.
- Low HDL-cholesterol ($<1.03$ mmol/L in male, $<1.29$ mmol/L in female), or specific treatment for this lipid abnormality.
- Increased fasting plasma glucose ($\geq 5.6$ mmol/L, oral glucose tolerance test is strongly recommended), or previously diagnosed diabetes.

**Development of a new formula to diagnose MS by WC and SFA8**

A new formula to diagnose MS and SFA8 was developed as following:

1. Calculating the normal value of SFA8 in the control group without MS.
2. Calculating the relationships between SFA8 and SBP, DBP, fasting plasma glucose, HDL-C and TG in both hypertension group and control group.
3. Developing a new formula for diagnosis of MS according to the high SFA8 and high WC.

**Statistical analysis**

The data were expressed as mean ± SD for continuous variables and percentage (%) for categorical variables. The mean of fasting glucose, blood pressure, anthropometrics and fasting plasma lipids were compared by unpaired Student’s $t$ test. Comparison of 2 percentages was done using Chi-square test ($\chi^2$). The sensitivity, specificity, false positive rate, false negative rate, positive predictive value and negative predictive value were analyzed between the new formula and the IDFA definition. A value of $P < 0.05$ was considered to be statistically significant. All of statistical analyses were performed by using SPSS 14.0.

**Results**

As presented in Table 2, the mean ages in the hypertension group and control group were the same ($P > 0.05$). The SBP and DBP in hypertensive patients with DM as well as the SBP and DBP in non-DM group were higher than the normotensive group ($P < 0.001$). Some anthropometrics in both DM and non-DM hypertensive patients (including BMI, WC and SFA8, respectively) were higher than those of the control group ($P < 0.001$), respectively. The fasting glucose and TG in the DM patients were higher than those of the non-DM patients ($P < 0.01$), respectively, and both were also higher than those of the control group ($P < 0.01$). However, the HDL-cholesterol of hypertensive group was lower than that of the control group ($P < 0.05$).

The SFA8 and WC in the MS patients and non-MS patients were shown in Table 3. Compared with non-MS patients, patients with MS had significantly higher SFA8 and WC. There was a correlation between SFA8 and SBP, DBP, fasting plasma glucose, HDL-cholesterol and TG in the control group (the correlation coefficients were 0.29, 0.23, 0.25, -0.31 and 0.46, respectively with $P < 0.01$, Table 4).

The WC was chosen as a major criterion for MS by the IDFA. The SFA8 could be used to replace other components of the definition such as increased TG levels, increased BP, low HDL-cholesterol and increased fasting plasma glucose. A new formula to diagnose MS is proposed using an increased WC and increase SFA8 as following: $\text{MS}=$ High WC ($\geq 90$ cm in male, $\geq 80$ cm in female) + SFA8 $\geq 30$ mm.

This new formula was retested in Table 5. The sensitivity, specificity, false positive rate, false negative rate, positive predictive value, and negative predictive value of the new formula compared with the IDFA definition were 94%, 93%, 7%, 6%, 92% and 95%, respectively in all patients. The formula correlated well in male, female, control group, hypertension group, overweight group, non-overweight group, intolerance glucose group, dyslipidemia group and different age group, respectively.

The prevalence percentages of MS diagnosed by the new formula and IDFA increased with age and BMI. But both of the prevalence percentages of MS were similar as compared between the new formula and IDFA criteria (Fig. 1, Fig. 2).

**Discussion**

The MS, a disorder of glucose and insulin metabolism, overweight and abdominal fat distribution, dyslipidemia and hypertension, is important because it is closely associated with the subsequent development of CVD and DM.12,14,19,23,39
Table 2. Clinical characteristics in the two groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Hypertensive group (n=358)</th>
<th>Normotensive group (n=151)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DM patients (n=80)</td>
<td>Non-DM patients (n=278)</td>
</tr>
<tr>
<td>Age, yrs</td>
<td>58.8±10.0</td>
<td>59.7±8.6</td>
</tr>
<tr>
<td>SBP, mmHg</td>
<td>163.0±26.6</td>
<td>158.0±23.9</td>
</tr>
<tr>
<td>DBP, mmHg</td>
<td>95.5±11.7</td>
<td>93.4±11.3</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>23.6±3.3†</td>
<td>22.6±2.6‡</td>
</tr>
<tr>
<td>WC, cm</td>
<td>86.7±8.6‡</td>
<td>83.0±8.2‡</td>
</tr>
<tr>
<td>SFA8, mm</td>
<td>36.1±11.6‡</td>
<td>32.1±9.9‡</td>
</tr>
<tr>
<td>Glucose, mmol/L</td>
<td>9.21±3.2†</td>
<td>5.38±0.95†</td>
</tr>
<tr>
<td>HDL-cholesterol, mmol/L</td>
<td>1.20±0.38*</td>
<td>1.25±0.38*</td>
</tr>
<tr>
<td>TG, mmol/L</td>
<td>3.25±2.84†</td>
<td>2.51±1.91†</td>
</tr>
</tbody>
</table>

DM, Diabetes mellitus; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; WC, waist circumference; SFA8, skin fold thickness at A8 point on Erdeheim diagram; HDL, high density lipoprotein; TG, triglyceride.

* P<0.05, † P<0.01, ‡ P<0.001 compared between DM and non-DM patients; non-DM patients and normotensive group; DM patients and normotensive group, respectively.

Most studies have reported that CVD and DM are the leading cause of morbidity and mortality in the world.18 Humans with DM have a two to fourfold higher risk of CVD compared with those non-DM. Lakka et al. in the Kuopio Ischaemic Heart Disease Risk Factor Study, showed a strong correlation between the MS and CVD and all-cause mortality in middle-aged men. This study was done on 1,209 men (aged 42-60 years at baseline during 1984-1989), who were initially free from CVD, cancer or DM, and were followed up during December 1998. The prevalence percentage of death due to coronary heart disease, CVD, and all-cause mortality were compared among men with MetS and those without MS by both WHO and NCEP definitions. Mortality was higher for those with MS, with relative risks of 3.77 (95%CI, 1.74-8.17), 3.55 (95%CI, 1.96-6.43) and 2.43 (95%CI, 1.64-3.61) for coronary heart disease, CVD and all-cause mortality, respectively. Early identification, treatment, and prevention of the MS present a major challenge for physicians and public health policymakers facing an epidemic of an overweight population and sedentary lifestyle.19 The WHO reported that NCDs are a growing burden for global health. NCDs, especially CVD today constitute the largest contributor to health care burden in terms of mortality or morbidity.14 According to WHO, 30% of all global deaths in 1998, accounting for 17.528 million lives lost in 2005, were due to CVD.69 The low- and middle-income countries contributed 78% of all CVD deaths and 86.3% of disability adjusted life year loss attributed to CVD that year.6 Almost one million Americans die of CVD each year "one person dies every 30 seconds from heart disease; that is over 2,600 people every single day" which adds up to 42% of all deaths. The medical care costs for CVD and DM also are staggering. The WHO estimates that DM, heart disease and stroke together will cost about 555.7 billion US dollar in lost national income China over the next ten years, 303.2 billion US dollar in the Russian Federation, 336.5 billion US dollar in India. Mohan and Deepa have described the growing threat from CVD and DM: in developing countries, CVD represent up to nearly 75% of deaths from NCDs and already accounts for 10% of the developing world's burden of disability, and
A distinction between increasing WC due to increase in SAT versus VAT is debated using computed tomography scanner and magnetic resonance imaging as measuring tools. With increased VAT, a higher rate of flux of adipose tissue derived free fatty acids to the liver through the splanchnic circulation would be expected, whereas increased SAT would release lipolysis products into the systemic circulation and avoid more direct effects on hepatic metabolism. Despite these potential differences in mechanisms related to excessive abdominal fat distribution, the clinical diagnosis of the MS does not distinguish between increases in VAT and SAT. Most studies suggest that VAT might be a powerful predictor of clinical outcomes linked to insulin resistance and it may be estimated by a simple anthropometric measurement such as WC. Guo et al. indicated that the elevated postprandial free acid release in the upper body of obese women originates from the non splanchnic upper body fat, and not from the VAT.

In Table 1, SAT is strongly correlated with insulin resistance and may be estimated by SF, particularly SFA8 is suspected to be closely correlated with insulin resistance in MS. In addition, SAT is where the principal product leptin and adiponectin may act and be anti-MS. Farvid et al. showed that plasma adiponectin levels were inversely related to SAT ($r=-0.500$, $P<0.001$), HOMA score ($r=-0.540$, $P<0.001$) and TG ($r=-0.632$, $P<0.001$), respectively. Lihn et al. reported adiponectin gene expression is lower in VAT than SAT suggesting SAT to be more important for circulating adiponectin levels. Tai ES and others showed plasma leptin levels and leptin gene were closely related to SAT ($r=0.56$, $P<0.01$).

In Table 3, SFA8 and WC in hypertensive patients (mean±SD)
A few studies reported people with normal WC (< 90 cm for Asia-Pacific criteria and < 94 cm for European criteria) who were diagnosed with MS by NCEP definition. This raises the question whether SAT is better than VAT in predicting MS by SF measurement. Can MS develop before an increase in WC? In addition, the diagnosis of MS becomes more complex if we need to use laboratory measurements. It is not advantageous to screen for MS in the whole population at large. This study developed a new simple formula to diagnose the MS using a high WC and high SF8. The new simple formula for defining MS is: high WC (≥ 90 cm in male, ≥ 80 cm in female) + high SF8 (≥ 30 mm). This new formula was compared to the IDFA definition and it was as useful as the IDFA definition in all subjects with a sensitivity, specificity, false positive rate, false negative rate, positive predictive value, and negative predictive value of the new formula compared with the IDFA definition at 94%, 93%, 7%, 6%, 92% and 95%, respectively. In addition, the new formula was also useful in males, females, the hypertension group, control group, overweight group, non-overweight group, intolerance glucose group, dyslipidemia group and following ages (including from 40 to 49, from 50 to 59, from 60 to 69 and ≥ 70, respectively) (Table 5).

The prevalence of MS differs between populations despite attempts to reach agreement on the definition of the MS because many studies compare the prevalence of MS using different definitions such as the WHO, NCEP and IDF, respectively. Ford et al. using the NCEP definition of MS, showed age-adjusted prevalence increased from 24.0% to 27.0% (P = 0.088) in the US. While in China according to IDF, the prevalence of MS was 13.3%, in Vietnam it was 18.5%. In 1998 the Singapore National Health survey involving 4,732 men and women of Chinese, Malay, and Asian-Indian ethnicity aged 18-69 years, the age-adjusted prevalence of the NCEP defined MS were 9.4%, 18.7% and 20.4% for Chinese, Malay, and Asian-Indian, respectively. However, the prevalence of MS increases with age and obesity and females have a higher prevalence than males. In China, the age-standardized prevalence of the NCEP defined MS was 9.8% in males and 17.8% in females. The National Health and Nutrition Examination Survey III, which was conducted among 8,814 US adults aged at least 20 years, the prevalence of MS using NCEP definition was 7.0% for males and 5% for females between the ages 20 to 29, and 44.0% for both genders aged from 60 to 69 years. Park et al. in the Third International Health and Nutrition Examination Survey, 1988-1994 reported the prevalence of the MS increased steeply after the third decade and reached a peak in men aged 50-70 years and in women aged 60-80 years. The prevalence was 4.6%, 22.4% and 59.6% of normal weight (BMI <

### Table 5. The sensitivity, specificity, false positive rate, false negative rate, positive predictive value and negative predictive value in different patient groups

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>False positive rate</th>
<th>Negative positive rate</th>
<th>Positive predictive value</th>
<th>Negative predictive value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects (n = 509)</td>
<td>0.94</td>
<td>0.93</td>
<td>0.07</td>
<td>0.06</td>
<td>0.92</td>
<td>0.95</td>
</tr>
<tr>
<td>Male (n = 268)</td>
<td>0.94</td>
<td>0.97</td>
<td>0.03</td>
<td>0.06</td>
<td>0.93</td>
<td>0.97</td>
</tr>
<tr>
<td>Female (n = 241)</td>
<td>0.94</td>
<td>0.86</td>
<td>0.14</td>
<td>0.06</td>
<td>0.92</td>
<td>0.89</td>
</tr>
<tr>
<td>Normotensive (n = 151)</td>
<td>0.97</td>
<td>0.90</td>
<td>0.10</td>
<td>0.03</td>
<td>0.81</td>
<td>0.99</td>
</tr>
<tr>
<td>Hypertensive (n = 358)</td>
<td>0.93</td>
<td>0.98</td>
<td>0.02</td>
<td>0.07</td>
<td>0.98</td>
<td>0.99</td>
</tr>
<tr>
<td>Overweight (n = 210)</td>
<td>0.96</td>
<td>0.90</td>
<td>0.10</td>
<td>0.04</td>
<td>0.97</td>
<td>0.88</td>
</tr>
<tr>
<td>Non-overweight (n = 299)</td>
<td>0.89</td>
<td>0.94</td>
<td>0.06</td>
<td>0.11</td>
<td>0.84</td>
<td>0.96</td>
</tr>
<tr>
<td>Glucose intolerance (n = 244)</td>
<td>0.95</td>
<td>0.99</td>
<td>0.01</td>
<td>0.05</td>
<td>0.99</td>
<td>0.93</td>
</tr>
<tr>
<td>Dyslipidemia (n = 398)</td>
<td>0.94</td>
<td>0.93</td>
<td>0.07</td>
<td>0.06</td>
<td>0.95</td>
<td>0.92</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49 (n = 121)</td>
<td>0.97</td>
<td>0.90</td>
<td>0.10</td>
<td>0.03</td>
<td>0.84</td>
<td>0.99</td>
</tr>
<tr>
<td>50-59 (n = 148)</td>
<td>0.94</td>
<td>0.94</td>
<td>0.06</td>
<td>0.06</td>
<td>0.93</td>
<td>0.95</td>
</tr>
<tr>
<td>60-69 (n = 155)</td>
<td>0.91</td>
<td>0.96</td>
<td>0.04</td>
<td>0.09</td>
<td>0.96</td>
<td>0.91</td>
</tr>
<tr>
<td>≥ 70 (n = 85)</td>
<td>0.95</td>
<td>0.96</td>
<td>0.04</td>
<td>0.05</td>
<td>0.95</td>
<td>0.96</td>
</tr>
</tbody>
</table>

IDFA, International Diabetes Federation for abdominal obesity as defined by Asia-Pacific criteria.
25 kg/m²), overweight (BMI from 25 to 29.9 kg/m²) and obese men (BMI ≥ 30 kg/m²), respectively.66 St-Onge et al. found the prevalence of MS in approximately 18.0% of white males and 23.0% of white females with BMI from 25 to 26.9 kg/m², and 9.0% of white males and 12.0% of white females with BMI from 23 to 24.9 kg/m².100 The results in this study show the prevalence of MS was not different between the new formula and the IDFA definition in all subjects, both genders, the control group and hypertension group, respectively (P > 0.05). The prevalence of MS in females was higher than the prevalence of MS in males (including all subjects, control group and hypertension group, respectively, P < 0.001). On the other hand, the results of this study were the same with results above using a new formula and IDFA according to ages and increase of BMI (kg/m²). There was no difference between the prevalence of MS by the new formula and the prevalence of MS by IDFA definition (P > 0.05) (Figs. 1, 2).

In conclusion, in the global epidemic of CVD, DM and obesity, Asia is being hit the hardest. Each year, over 17 million people die from stroke and heart disease in the world. Of these deaths, 11 million will occur in developing regions, including Asia. Approximately 1.000 million people worldwide are overweight; over 388 million people are expected to die from a NCD in next ten years, mainly caused by CVD. It is necessary to prevent early the burden of disease caused by MS. A new formula for MS was developed and might be useful for easy screening of MS. It has a big advantage because there is no need for laboratory testing and will save clinical costs for screening large populations.

References


