

Metabolic Syndrome and Hypertension Subtypes among Untreated Hypertensive Rural Chinese

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Abstract

Background: High blood pressure is a major contributor to metabolic syndrome (MS) and the selection for hypertension in most cases is associated with higher prevalence of MS. However, the relation between hypertension subtypes and MS is not well defined.

Methods: A cross-sectional survey was conducted during 2004-2006, which undertook cluster multistage sampling to a representation sample in rural villages of Liaoning, China. A total of 4273 untreated hypertensive subjects aged ≥ 35 years were selected. The metabolic syndrome was defined by the National Cholesterol Education Program. Hypertension consisted of three subtypes: Isolated Systolic Hypertension (ISH), Isolated Diastolic Hypertension (IDH), and Systolic-Diastolic Hypertension (SDH).

Results: Of the study population 23.4% (men: 12.0%, women: 33.4%) had metabolic syndrome. Overall, 24.4% (men: 22.2%, women: 26.3%), 10.0% (men: 9.5%, women: 10.5%), and 65.6% (men: 68.4%, women: 63.3%) of the untreated hypertensive individuals had ISH, IDH, and SDH, respectively. The MS prevalence in untreated persons was 23.2% (men: 11.3%, women: 31.9%) for ISH, 18.7% (men: 9.5%, women: 26.1%) for IDH, and 24.1% (men: 12.5%, women: 35.2%) for SDH. Among those with MS, 24.1% (men: 20.9%, women: 25.2%) had ISH, 8.0% (men: 7.5%, women: 8.2%) had IDH, and 67.8% (men: 71.5%, women: 66.7%) had SDH.

Conclusions: SDH was the most prevalent hypertensive subtype; however, the prevalence of MS was similar in persons with ISH or SDH. Additionally, the high frequency of SDH in the hypertensive population made SDH the most common hypertensive subtype in persons with MS.

Keywords: Metabolic syndrome; Hypertension; Rural population; Epidemiology

Introduction

Metabolic syndrome (MS), a constellation of risk factors associated with vascular diseases is becoming a major public health issue not only prevalent among US and European populations [1,2], but also among the developing countries. Several prospective studies have shown that the MS was associated with increased morbidity or mortality not only for patients with cardiovascular disease [3,4] but also for patients with stroke events [5,6]. As an element of MS, hypertension is the key role associated with the significantly increasing cardiovascular mortality [7]. Studies have also indicated that hypertension subtypes were significantly associated with cardiac and cerebrovascular events. Previous evidence from prospective epidemiological studies reported that isolated systolic hypertension (ISH) was the single greatest risk factor, other than age, for the development of cardiovascular diseases in the elderly population [8,9]. Given that individuals with ISH had higher prevalence of left ventricular hypertrophy and carotid atherosclerosis than subjects with diastolic hypertension despite lower mean blood pressure [10]. Other studies showed that systolic-diastolic hypertension (SDH) patients were at the highest risk of cardiovascular disease or stroke among all the hypertensives [11,12]. However the comparative relation of hypertension subtypes to the odds of having MS has not been well defined. The goal of the current study was therefore to estimate whether each hypertension subtype were related to the likelihood of MS.

Methods

Study population

The procedures followed were in accordance with ethical standards of the responsible committee on human experimentation of China

Medical University. A cross-sectional survey was conducted from Oct 2004 to June 2006 in Liaoning province of China. The study used a cluster multistage sampling method, which included samples from rural hypertensives in the northern, southern, western, eastern, and the central regions of Fuxin county in Liaoning province. Only 1 small town was selected from each region. Finally, 10 rural villages near each small town were randomly selected from different geographic areas. In total, 5 small towns from these regions, and 50 rural villages were selected to a resident group. A total of 4273 untreated hypertensive subjects (men 1998, women 2275) aged ≥ 35 years were selected.

Measurements

The baseline surveys were conducted by local doctors with home visits method. During the interview and examination, doctors administered a standard questionnaire including questions related to demographic variables (age, sex, and race). Blood pressure (BP) was measured with a checked electronic sphygmomanometer (Omron) and three blood pressure measurements were taken. At the study site, anthropometric measurements including waist circumference, height, and weight were obtained from each participant with standard

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protocols. Subjects were asked to fast for at least 12 hours before blood collection. Blood samples were obtained from an antecubital vein into vacutainer tubes containing EDTA. Blood chemical analyses were performed at a central, certified laboratory. Blood lipids and fasting glucose were analyzed enzymatically on an Olympus AU640 autoanalyzer.

Definitions

MS is defined according to ATP III criteria [13] as the presence of three or more of the following components:

1) Elevated BP: systolic BP ≥ 130 mmHg, diastolic BP ≥ 85 mmHg, or use of antihypertensive medications; 2) Elevated plasma glucose: fasting glucose ≥ 6.1 mmol/L (110mg/dl), self-reported physician diagnosed diabetes, or self-reported use of hypoglycemic agent or insulin; 3) Elevated serum TG: ≥ 1.7 mmol/L (150mg/dl); 4) Decreased HDL-cholesterol: < 1.0 mmol/L (40mg/dl) for men and < 1.3 mmol/L (50mg/dl) for women; and 5) Higher WC: ≥ 102 cm for men and ≥ 88 cm for women. Untreated hypertension was considered without antihypertensive treatment and present if any of the following conditions were met: systolic blood pressure (SBP) ≥ 140 mmHg, diastolic blood pressure (DBP) ≥ 90 mmHg. Subtypes of hypertension were defined according to the baseline SBP, DBP: ISH (SBP ≥ 140 mmHg and DBP < 90 mmHg); SDH (SBP ≥ 140 mmHg and DBP ≥ 90 mmHg); isolated diastolic hypertension (IDH) (SBP < 140 mmHg and DBP ≥ 90 mmHg).

Statistical analysis

To account for the clustering and stratification of the survey design, and to adjust for non-response, the data were weighted to match the age distribution of the 2000 China Population Census data aged ≥ 35 years, unless otherwise stated. The weighting factor was based on the probability of selection in each cluster. Therefore, all prevalence relate to the total 2000 China population aged ≥ 35 years. All data analyses were conducted by use of SPSS 11.5 (SPSS Inc., Chicago, IL) statistical software package. Continuous variables were presented as mean values and standard deviation. Categorical variables were presented as frequencies. The prevalence estimates of MS categories were calculated by age, gender and hypertension subtypes -specific proportions. A chi-square test was used to examine gender and hypertension subtypes differences. For all comparisons, p -values < 0.05 were considered statistically significant.

Results

Basic characteristics of study population

The characteristics of the untreated hypertensive individuals enrolled in this study, as stratified by gender, are shown in Table 1. All subjects were selected from 35 to 92 years old and the average ages of the men and the women were 57.41 ± 11.57 and 55.70 ± 11.20 years, respectively. Compare with women, untreated hypertensive men had significantly higher prevalence of SDH, levels of age and DBP. However, levels of HDL-cholesterol, prevalence of ISH were lower in untreated hypertensive women. The SBP levels, waist circumference levels, triglycerid levels and prevalence of IDH were not shown significant differences across different gender.

Prevalence of metabolic syndrome and hypertension subtypes

As shown in Table 2, approximately 23.4% of the untreated hypertensive individuals had MS. The prevalence of MS was significantly higher in women than that in men ($p < 0.001$). For men, the prevalence of MS declined gradually with age. For women, the highest prevalence

of MS was in the decade aged 55-64; however, it decreased obviously when age ≥ 65 years.

Overall, 24.4% (men: 22.2%, women: 26.3%), 10.0% (men: 9.5%, women: 10.5%), and 65.6% (men: 68.4%, women: 63.3%) of the untreated hypertensive individuals had ISH, IDH, and SDH, respectively. The MS prevalence in untreated persons was 23.2% (men: 11.3%, women: 31.9%) for ISH, 18.7% (men: 9.5%, women: 26.1%) for IDH, and 24.1% (men: 12.5%, women: 35.2%) for SDH ($p < 0.05$). Compared with men, untreated hypertensive women had significantly higher prevalence of MS among different hypertensive subtypes ($p < 0.001$) (Figure 1).

As presents in Figure 2 and 3, among those with MS, 24.1% (men: 20.9%, women: 25.2%) had ISH, 8.0% (men: 7.5%, women: 8.2%) had IDH, and 67.8% (men: 71.5%, women: 66.7%) had SDH; for those without MS the corresponding figure was 24.4%, 10.6%, and 65.0%, respectively. In general, for people with MS, the proportion of individuals with IDH and SDH was progressively lower and the proportion of individuals with ISH was progressively higher with increments of age when age ≥ 45 years, whereas this was happen when age ≥ 35 years in people without MS.

Prevalence of MS components clusters by hypertension subtypes

The prevalence of MS components clusters as follow: for ISH, 34.5%, 17.8%, 4.7%, and 0.7% of the study individuals had 1, 2, 3, and 4 components, respectively; for IDH the corresponding figure was 38.2%, 13.8%, 4.2%, and 0.7%, respectively; and for SDH 36.4%, 18.8%, 4.6%, 0.8%.

Discussion

The main findings of this study were that the highest prevalence of hypertension subtypes was SDH (65.6%) among untreated rural hypertensive Chinese population; subjects with SDH had the highest prevalence of MS (24.1%) as compared with those individuals with

Characteristic	Men (n=1998)	Women (n=2275)	p values
Age (years)	57.41 \pm 11.57	55.70 \pm 11.20	<0.001
Systolic blood pressure (mmHg)	159.31 \pm 22.25	158.84 \pm 21.13	0.462
Diastolic blood pressure (mmHg)	95.70 \pm 12.46	93.87 \pm 11.33	<0.001
Waist circumference (cm)	82.69 \pm 9.00	82.35 \pm 10.23	0.258
HDL cholesterol (mmol/L)	1.43 \pm 0.33	1.45 \pm 0.33	0.016
Triglycerid (mmol/L)	1.69 \pm 1.90	1.76 \pm 1.38	0.174
Fasting blood glucose (mmol/L)	5.70 \pm 1.50	5.71 \pm 1.83	0.806
Isolated systolic hypertension (%)	22.2	26.3	0.002
Isolated diastolic hypertension (%)	9.5	10.5	0.276
Systolic-diastolic hypertension (%)	68.4	63.3	<0.001

Table 1: Clinical characteristics of the untreated individuals.

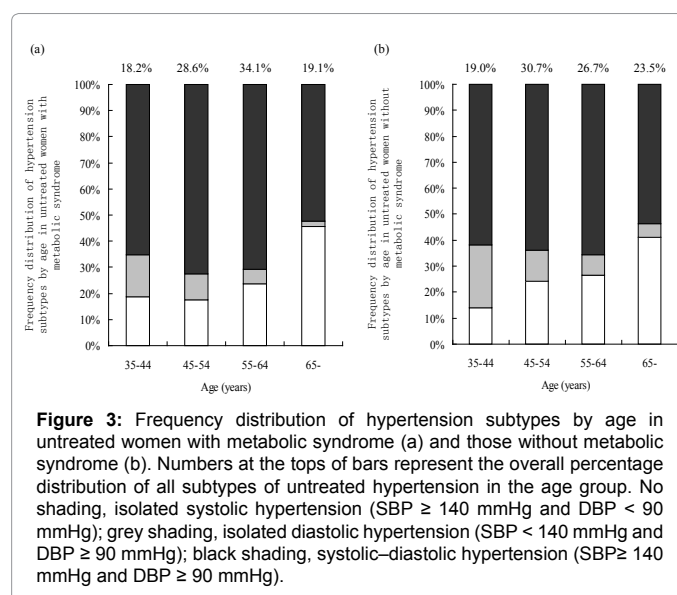
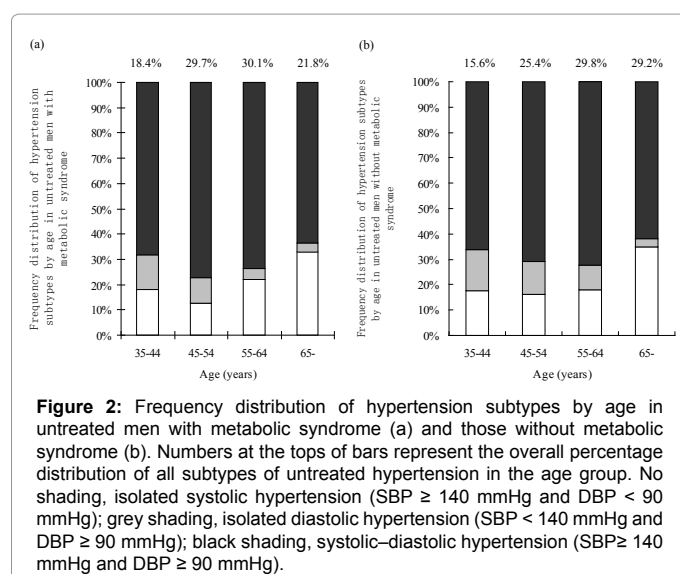
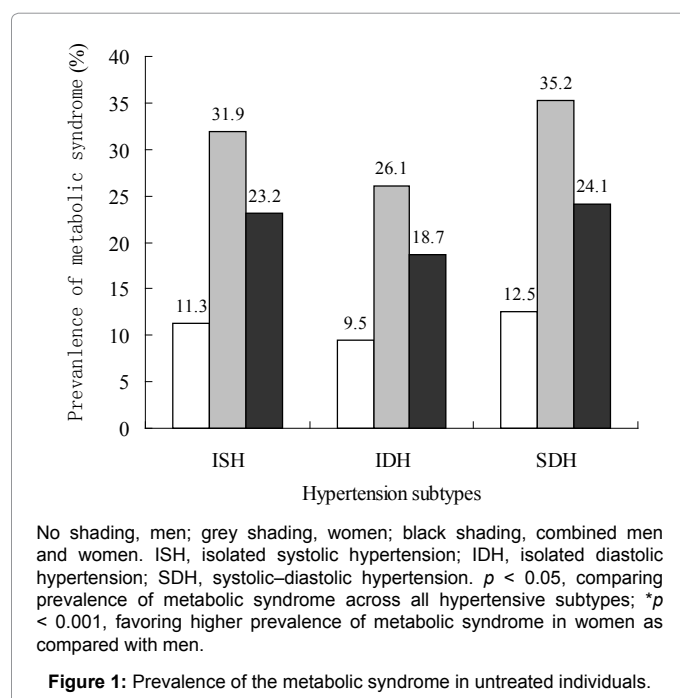
Age (years)	Men (n=1998)	Women (n=2275)	All (n=4273)
35-44	44(13.8)	138(32.4)	182(24.5)
45-54	71(13.7)	217(31.8)	288(24.0)
55-64	72(12.1)	259(39.0)	331(26.2)
≥ 65	52(9.2)	145(28.9)	197(18.4)
Total	239(12.0)	759(33.4)	998(23.4)

Data are n (%). *: men compare with women $p < 0.001$

Table 2: Prevalence of metabolic syndrome by gender and age group in untreated individuals.

IDH (18.7%) or ISH (23.2%); women compared with men showed significantly higher presence of MS in all three hypertension subtypes; SDH was the most prevalent hypertension subtype (67.8%) in people with MS; persons with only one MS component were the most common whatever hypertension subtypes.

Previous studies in China have shown that SDH was the most common hypertension subtype and participants with SDH were at the highest risk for any cardiovascular event [11,12,14]. The results of this current investigation reinforce the findings of previous study, which showed that SDH was the most prevalent hypertension subtype. In contrast, some studies reported that ISH was the most common hypertensive subtype and was associated with a higher risk of cardiovascular disease [15–17]. The discrepancies across studies were unclear; however, age distribution might be an important reason. Evidence from previous studies showed that the relative importance



of SBP decreased with decreasing age, further compared with SBP, DBP was a stronger predictor of coronary heart disease morbidity and mortality when subjects aged ≤ 45 years [18]. Other study also found that ISH was the most common hypertension subtype in participants of age ≥ 50 years. Conversely, for the younger hypertensive group, IDH was the most frequent form of hypertension and was comparable in prevalence with SDH [19].

The differences in proportion of hypertension subtype result in different prevalence of MS. In the current study, MS was more prevalent in patients with SDH rather than people with ISH or IDH. Different result was found by Franklin et al. that IDH subtype was associated with greatest likelihood of MS [20]. There was no sufficient explanation for these differences, the heterogeneity of the study populations may be an important reason and biological interactions between risk factors may be another important reason. As study pointed that age, daily cigarette smoking dose and the types of vitamins ingested was probably the most important risk factor for ISH, IDH and SDH, respectively. However, the other risk factors such as being age, family history of tumors, frequency of consumption of seafood, body weight, and total number of cigarettes were also associated with the different subtypes of hypertension [21].

In conclusion, the present study documented a high prevalence of SDH among rural hypertensive Chinese adults and showed significant association between hypertension subtype and MS, although differences were observed between studies. Since SDH was the most common form of hypertension and also the most prevalent hypertension subtype with MS, optimal reduction in cardiovascular risk frequently required concurrent treatment of both hypertension and other elements of MS in this rural hypertensive population.

Our study has several limitations. The major limitation is the cross-sectional design, which cannot establish causal relations but can only generate hypotheses about the associations between hypertension subtype and MS of the participants. In this study, the sample contains only hypertensives, lacking normotensives for comparison. Other limitations include the possible misclassification of recall bias and confounding factors.

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