Prevalence and risk factors of hypertension among pre- and post-menopausal women: A cross-sectional study in a rural area of northeast China

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ABSTRACT

Objectives: The aim of this study was to assess the prevalence and risk factors of hypertension in pre-menopausal women (Pre-MW) and post-menopausal women (Post-MW) and determine whether years since menopause (YSM) is associated with hypertension.

Methods: A cross-sectional study was conducted with 6324 women over 35 years of age (2616 Pre-MW and 3708 Post-MW). Questionnaires, measurements and blood biochemical indexes were collected.

Results: The overall prevalence of hypertension among women in rural northeast China was 48.8%, and it increased with age. Post-MW had a higher prevalence of hypertension than Pre-MW (62.4% vs. 29.7%, $P < 0.01$). After controlling for confounding variables, overweight (OR = 1.97, 95% CI: 1.72–2.25), obesity (OR = 2.97, 95% CI: 2.30–3.84), diabetes mellitus (OR = 2.13, 95% CI: 1.73–2.62), high triglycerides (OR = 1.41, 95% CI: 1.20–1.65), and history of cardiovascular diseases in first-degree relatives (OR = 1.60, 95% CI: 1.42–1.81) were associated with hypertension in all participants. However, abdominal obesity (OR = 1.29, 95% CI: 1.05–1.58) was associated with higher odds among Post-MW only. Hypertension was associated with being postmenopausal (OR = 1.22; 95% CI: 1.03–1.46), and the risk of hypertension reached a peak level in the <5-year group (OR = 1.29; 95% CI, 1.07–1.57).

Conclusions: Postmenopausal status was an independent risk factor for hypertension. The risk of hypertension was highest in Post-MW with ≤5 YSM and then decreased. Other risk factors of hypertension were body mass index (BMI), abdominal obesity, a family history of cardiovascular disease among first-degree relatives, a personal history of diabetes, and high TG.

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1. Introduction

Cardiovascular disease (CVD), including both heart and cerebrovascular disease, is the leading cause of death in China [1] and hypertension has been identified as the major risk factor for CVD [2]. Post-menopausal women (Post-MW) are at increased risk of CVD [3] and the prevalence of hypertension in women increases when they reach menopause [4]. Indeed, until 45 years of age, the prevalence of hypertension tends to be lower in women than in men. The rates are similar in men and women between 45 and 54 years of age; and after 55 years of age, the prevalence is higher in women [5]. However, given the effects of aging and other significant risk factors such as body weight and cholesterol level on the cardiovascular system, results of studies on the relationship between menopausal status and hypertension are not consistent.

The observations of cross-sectional and longitudinal studies have been variable. Some cross-sectional studies suggested Post-MW were at greater risk of being hypertensive than premenopausal women (Pre-MW) independent of age and body mass index (BMI) [6,7], but other studies found no significant association between hypertension and menopausal status after adjusting for age [8,9]. However, although the prevalence of hypertension in rural Chinese women is high, awareness and control are low [10], and study of the relationship between menopausal status and hypertension has been limited. Because hypertension is one of the most important

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preventable contributors to disease and death [11], a better understanding of its epidemiology and risk during menopause is crucial for improving therapeutic strategies, survival and quality of life.

This multistage, stratified study used random-cluster sampling to recruit 6324 women across rural China. The study was designed to estimate the prevalence and characterize risk factors of hypertension among Pre-MW and Post-MW in a rural area of northeast China, especially to clarify the association between menopausal status and hypertension independent of confounding variables. Another objective was to determine whether years since menopause (YSM) was associated with hypertension.

2. Methods

2.1. Study population

From January 2012 to August 2013, a representative sample of women ≥35 years of age was recruited in rural areas of Liaoning Province in northeast China with the aim describing the prevalence, incidence, and natural history of cardiovascular risk factors. This multistage study used random-cluster sampling of different population strata. In the first stage, three counties (Dawa, Zhangwu, and Liaoyang) in the eastern, southern, and northern regions of Liaoning province were selected. In the second stage, one town was randomly selected from each county (a total of three towns). In the third stage, 8–10 rural villages were randomly selected from each town (a total of 26 rural villages).

Women who were pregnant, had malignant tumors, or mental disorders were excluded from the study. All the eligible permanent residents of each village who were ≥35 years of age were invited to participate (a total of 14,016 participants). Of those, 11,956 (85.3%) agreed and completed the study. The Ethics Committee of China Medical University (Shenyang, China) approved the study, and all procedures were performed in accordance with ethical standards. Written consent was obtained from all participants after they had been informed of the objectives, benefits, medical content, and confidentiality of personal information. Informed consent was obtained from proxies of illiterate residents. A final sample of 6324 women with a complete set of baseline data for the variables analyzed in the study were evaluated.

2.2. Data collection and measurements

Data were collected by cardiologists and trained nurses using a standard questionnaire in a face-to-face interview during a single clinic visit. Study staff attended training sessions, and only those who achieved a perfect score on a subsequent evaluation were accepted. Investigators received ongoing instruction and support during the data collection period.

Data collected by the questionnaire included demographic characteristics and lifestyle habits. The former consisted of age, gender, race, family history of disease, financial status, educational level, and marital status. Participants were asked whether they had experienced menopause and those who answered "yes" were asked to give the age at which it began. None of the participants received hormone replacement therapy within 2 weeks of, or during the survey. Lifestyle questions collected data on smoking status, alcohol consumption, intensity of occupational activity, and sleep-time per night. Questionnaires were monitored by a central steering committee with a subcommittee for quality control.

Family history included diseases in first-degree relatives including parents, offspring and siblings. Educational level was recorded as primary school or below, middle school, and high school or above. Financial status was divided into three levels, less than 5000, 5000 to 20,000, and more than 20,000 Chinese yuan (CNY) local annual income. Smoking and alcohol status were divided into current smokers/drinkers and nonsmokers/drinkers. Sleep duration, including hours of both nocturnal sleep and naps, was self-reported on the questionnaires. The responses were reported as ≤7, 7–8, 8–9, and >9 h/day.

Blood pressure (BP) was measured three times at 2 min intervals after a rest period of least 5 min following an American Heart Association protocol. An automatic electronic sphygmomanometer (HEM-907; Omron), previously validated according to the British Hypertension Society protocol [12], was used. Weight and height were measured to the nearest 0.5 kg and 0.1 cm. Waist circumference (WC) was measured to the nearest 0.1 cm at the midpoint between the lower rib and upper margin of the iliac crest using a nonelastic tape and with the participants standing at the end of a normal expiration.

Blood samples were collected from the antecubital vein in the morning after at least a 12 h fast. Vacutainer tubes containing EDTA were used. Fasting plasma glucose (FPG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), triglycerides (TG) and other routine blood biochemical indexes were assayed enzymatically with an autoanalyzer. All laboratory equipment was calibrated, and tests were run in duplicate in a blinded fashion.

2.3. Definitions

Following JNC-7 report guidelines [13], hypertension was defined as a systolic blood pressure (SBP) ≥140 mmHg, and/or diastolic blood pressure (DBP) ≥90 mmHg, and/or use of antihypertensive medications. Participants were divided into three groups by normal BMI (<25 kg/m^2), overweight (25 ≤ BMI <30 kg/m^2), and obese (BMI ≥ 30 kg/m^2), according to the World Health Organization (WHO) criteria [14]. Abdominal obesity was defined as a WC ≥ 88 cm [15]. Dyslipidemia was defined according to the National Cholesterol Education Program Third Adult Treatment Panel (ATP III) criteria [16]. High TC was defined as ≥6.21 mmol/L (240 mg/dL). High TG was defined as ≥2.26 mmol/L (200 mg/dL). Diabetes mellitus was diagnosed by the WHO criteria, i.e., FPG ≥ 7 mmol/L (126 mg/dL) and/or being on treatment for diabetes [17]. A woman was considered postmenopausal if she reported menses had ceased for 1 year or more, and age at menopause was self-reported.

Occupational physical activity was divided into three categories: low (participants reported a low level of activity); moderate (participants reported a moderate level of activity); and high (participants reported a high level of activity).

2.4. Statistical analysis

Descriptive statistics were calculated, with continuous variables reported as mean ± standard deviation (SD) and categorical variables as numbers and percentages. Differences between Pre-MW and Post-MW were evaluated using Student's t-test or the χ^2 test as appropriate. Multivariate logistic regression was used to identify the association between hypertension and related risk factors using odds ratios (ORs) and 95% confidence intervals (CIs). All statistical analyses were performed using SPSS version 19.0 software (IBM Corp., Armonk, NY, USA), and P values less than 0.05 were considered to be statistically significant.

3. Results

The total study population comprised 6324 female participants with a mean age of 53.4 ± 10.3 years. A total of 3708 women (58.6%) had experienced menopause at a median age of 48.9 ± 4.1 years. Age-specific prevalence rates for hypertension are shown in Fig. 1.