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Assessment of risk factors for cerebrovascular disease among the elderly in Beijing: A 23-year community-based prospective study in China

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ABSTRACT

Introduction: There are few studies on how lifestyle factors and mental conditions modulate the cerebrovascular diseases (CBVD) mortality risk are rare in the Asian elderly.

Aim: To comprehensively assess the impact of lifestyle factors and mental conditions on the mortality risk of CBVD among the Chinese older adults.

Material and methods: This community-based prospective cohort study was based on the Beijing Longitudinal Study of Aging. We included 2101 participants aged ≥55 years who were interviewed in August 1992 and followed until December 2015. Baseline sociodemographic variables, lifestyle behaviors, and medical conditions were collected using a standard questionnaire. In addition, biochemical parameters, the Activities of Daily Living (ADL) scale, Center for Epidemiological Studies Depression (CES-D) scale, and Mini-Mental State Examination (MMSE) were performed. Hazard ratio (HR) and 95% confidence intervals (CI) was estimated from the competing risk model.

Results: During the follow-up period, 576 (27.42%) CBVD events were documented. Multivariable analysis showed that hypertension (HR = 2.331, 95% CI = 1.652–3.288,$P < 0.001$), depression (HR = 2.331, 95% CI = 1.652-3.288, $P < 0.001$), cognitive impairment (HR = 1.382, 95% CI = 1.132-1.689, $P < 0.001$), and coronary heart diseases (HR = 1.360, 95% CI = 1.095-1.689, $P = 0.005$) were independently associated with CBVD, while body mass index, fasting blood glucose, triglycerides, drinking, and smoking were not associated with CBVD (all $P > 0.05$).

Conclusions: Males were at higher risk of CBVD than females. Age, gender, hypertension, cognitive impairment, and depression were associated with CBVD among the elderly in Beijing, China.

1. Introduction

Cerebrovascular diseases (CBVD) include ischemic and hemorrhagic stroke and transient ischemic attacks (TIA). CBVD is the second leading cause of death globally after ischemic coronary heart disease, accounting for a combined 15 million all-cause mortality (World Health Organization, 2015). The incidence of stroke is similar between high- and low-income countries (ranging from 217 to 281 per 100,000 person-years), but the mortality is lower in high-income countries compared with low-income countries (61 vs. 105 per 100,000 person-years) (Feigin et al., 2014). The incidence of CBVD has increased by 100% in developing countries (Thrift et al., 2017). In China, the standardized CBVD-related death rate is 124.15 in women and 148.57 in men per 100,000 people per year (Sun, Zou, & Liu, 2013).

The mortality and disability due to CBVD is expected to increase in the future because of aging population and change of lifestyles (Feigin, Norrving, & Mensah, 2017). The risk factors for CBVD include history of TIA, cardiovascular diseases (hypertension, myocardial infarction, atrial fibrillation, atrial tachyarrhythmia, and left atrial enlargement), smoking, metabolic syndrome, obesity, heavy alcohol use, diabetes

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mellitus type 2, high cholesterol levels, and carotid artery stenosis (O'Donnell et al., 2016). Fortunately, some risk factors such as dietary habits (high sodium intake, high intake of processed foods, and low intake of fruits, vegetables, fish, and whole grains), poor physical function, and substance abuse are modifiable (Jauch et al., 2013). However, others factors associated with mortality due to CBVD such as older age, the number of neurological deficits, being Caucasian are unmodifiable (Xian, Holloway, Noyes, Shah, & Friedman, 2011).

As reported in previous studies, age, male, stroke severity, hemorrhagic stroke, diabetes, ischemic heart disease, and right hemisphere stroke were independently associated with mortality from CBVD, while atrial fibrillation, antihypertensive treatment at admission, smoking, or living alone were also associated with CBVD (Ronning, 2013). In addition, Guo et al. founded that elderly people (especially women) with low score mini-mental state examination (MMSE) score were at higher risk of CBVD (Guo et al., 2017). However, studies on the combined impact of lifestyle factors and mental conditions (such as depression and cognitive impairment) on the CBVD mortality risk in the Asian elderly population are few.

The present study aimed to develop a comprehensive model for CBVD mortality by incorporating the effects of lifestyle factors and mental conditions among the older Chinese population in a 23-year community-based prospective cohort study. We hypothesized that (1) depression or cognitive impairment were independently associated with increased risk of CBVD; (2) clustering of CBVD risk factors was strongly associated with a high risk of CBVD mortality.

2. Methods

2.1. Study design and participants

This study was based on a secondary analysis of the Beijing Longitudinal Study of Aging (BLSA), a community-based prospective cohort study (Tang et al., 1999). The procedures for sampling and data collection were described in details elsewhere (Tang et al., 1999; Tian et al., 2011). Briefly, a three-stage stratification random clustering sampling procedure (i.e., urban and rural-level sampling, neighborhood community-level sampling, and respondent-level sampling) was used to obtain a representative sample in Beijing in August 1992. Finally, 3257 participants were included from three districts of Beijing: Xuanwu, Daxing, and Huairou. In this study, 2101 participants aged ≥55 years were included after agreeing undertake a blood examination test. The included and the excluded sample were compared to assess enrolment bias; the differences in baseline characteristics between these two groups were not statistically significant.

This study was approved by the ethics committee of the Xuanwu Hospital affiliated to the Capital Medical University (Approval No.: 2015SY52). Written informed consents were originally obtained for each participant.

2.2. Data collection

A standard questionnaire including demographic characteristics, socioeconomic status, and health conditions was applied at baseline data collection. The questionnaire was a modified version of that used in the English Longitudinal Studies on Aging (ELSA) (Steptoe, Breeze, Banks, & Nazroo, 2013). The questionnaire was completed at home by trained interviewers (nurses, doctors, or senior medical students). These personnel helped the illiterate participants to complete the questionnaire, where necessary.

2.3. Assessment of risk factors

Demographic characteristics included: age, gender, marital status, and education level. Smoking and drinking status were ascertained from self-administered questionnaires. Age was categorized into three groups: 55–65 years, 66–75 years, and > 75 years. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2) and grouped into four categories: thin (< 18.5 kg/m^2), normal (18.5–23 kg/m^2), overweight (23–30 kg/m^2), and obesity (> 30 kg/m^2) (Chen, Lu, Department of Disease Control Ministry of Health, & P.R.C, 2004). Blood pressure (BP) was measured by a trained nurse on the right arm of participants seated after resting for ≥10 min. Participants were classified into three groups: high (systolic blood pressure (SBP) ≥140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg), critical (140 > SBP ≥120 mmHg or 90 > DBP ≥80 mmHg), and normal (SBP < 120 mmHg and DBP > 80 mmHg) (Liu, 2011).

Blood samples were collected after overnight fasting for ≥12 h. Fasting plasma glucose (FBG), total cholesterol (TC), high-density lipoprotein-cholesterol (HDL-C), low-density lipoprotein-cholesterol (LDL-C), and triglycerides (TG) were measured using standardized enzymatic methods. Participants who had TC ≥ 200 mg/dL (5.18 mmol/L), or TG ≥ 150 mg/dL (1.70 mmol/L), or HDL-C ≥ 40 mg/dL (1.03 mmol/L) for men and ≥50 mg/dL (1.29 mmol/L) for women, or LDL-C ≥ 130 mg/dL (3.37 mmol/L) were considered to be dyslipidemic (Wu, 2007). Diabetes mellitus was defined as self-reported history of diabetes diagnosis or using the antidiabetic medicine after the baseline examination, or FBG ≥ 126 mg/dL (7.0 mmol/L) (Alberti & Zimmet, 1998). Impaired fasting glucose was identified having a FPG level of 109.8–125.9 mg/dL (6.1–6.9 mmol/L) (Alberti & Zimmet, 1998).

The questionnaire also included the frequency of doing exercise: if the participant exercised regularly (almost every day), then this was defined as exercising frequently. Participants were asked, "Do you eat fresh fruit almost every day? and "Do you eat fresh vegetables almost every day?". A possible answer was "yes" or "no".

Physical function was assessed using the Instrumental Activities of Daily Living (ADL) scale (Jefferson et al., 2008). ADL scale included 6 items of daily activities (walking, getting out of bed, feeding, dressing, bathing, and toileting). A participant was categorized as disabled if he/she was unable to complete at least one of the above activities alone.

Depression was assessed using a 20-item measure of the Center for Epidemiological Studies Depressive symptoms scale (CES-D) (Radloff, 1977). The CES-D has a high sensitivity and specificity for major depressive symptoms among the elderly. The total scores ranged from 0 to 30, and a cut-off value ≥16 was used to identify depression (Radloff, 1977).

The Mini-Mental State Examination (MMSE) was used to measure the global cognitive function (Li et al., 2012). The MMSE scale included five domains: orientation, attention, calculation, recall, and language. The total score ranged from 0 to 30, with higher scores representing good cognitive ability. Cognitive impairment was defined based on the education level and MMSE score. The cutoff values were as follows: illiterate < 17, primary school education < 20, and secondary or higher education < 24.

2.4. Outcome assessment

CBVD incidence and/or mortality was defined as the primary cause of death as indicated by the International Classification of Disease (ICD)-10 (I60-169). Deaths from cardiovascular diseases, cancers, and other causes were considered as competing events.

2.5. Statistical analysis

Since a few serum biochemical values were missing, multiple imputation (MI) was performed to impute the missing information. According to data distribution, the Markov Chain Monte Carlo (MCMC) method was used to avoid the loss of generality. The "PROC MI" procedure in the SAS software package (Version 9.2; SAS Institute, Chicago, IL, USA) was used. Follow-up time was calculated from the initial date of the 1992 questionnaire to CBVD incidence, mortality, loss to follow-up, or end of follow-up (December 31, 2015), whichever came