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Prevalence of cardiovascular disease risk factor clustering in Chinese adults

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ABSTRACT

Cardiovascular disease (CVD) is now the most prevalent and debilitating disease affecting the Chinese population, we aim to provide the latest nationwide estimates on the prevalence of main CVD risk factors. Using a complex, multistage, probability sampling design, a cross-sectional study was performed in a nationally representative sample of 17,708 adults aged 45 years and older from 28 provinces in 2011–2012. Overall, the age-standardized prevalence of subjects having 1, 2, 3, or ≥4 of the 5 risk factors was 30.5%, 29.8%, 19.7%, and 7.4%, respectively. The prevalence of being dyslipidemia, hypertension, diabetes, current smoking, and overweight or obese was 62.6%, 39.9%, 18.7%, 27.5%, and 32.6%, respectively. Clustering of CVD risk factors was a high health burden in the Chinese middle aged and elderly population. These results underscore the need for strategies aimed at the prevention, detection, and treatment of cardiovascular risk factors to reduce morbidity and mortality from cardiovascular disease.

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1. Introduction

Cardiovascular disease (CVD) is the leading cause of death globally, accounting for 30% of deaths and resulted in 17.5 million deaths [1,2], which is predicted to increase to approximately 25 million deaths by 2020 [3]. Modifiable risk factors for CVD, mainly including hypertension, smoking, abdominal obesity, abnormal lipids, and diabetes mellitus, are the major contributors to cardiovascular morbidity and mortality [4], accounting for more than 90% of all myocardial infarctions [5]. Total global mortality estimates [6–8] showed that the top 3 causes of death in industrialized countries are hypertension, tobacco use, and high Body-mass index (BMI)—all high-profile risk factors for CVD. Furthermore, similar trends are now emerging in economically developing countries as the population aging and lifestyles in lower- and middle-income countries become more akin to those of wealthier nations [9,10].

And according to the previous surveys, included the 2000–2001 International Collaborative Study of Cardiovascular Disease in ASIA (InterASIA) [11] and the 2007–08 China National Diabetes and Metabolic Disorders Study [12], CVD and main CVD risk factors were also the most prevalent and debilitating disease affecting the Chinese population. China is currently experiencing rapid economic, social and cultural changes, including accelerated pace of nutrition transition and changes in people's lifestyles that may contribute to greatly increased burden of CVD. Understanding the prevalence of CVD risk factors in the national level is important to develop the effective programs and strategies to lower the population burden of illness due to CVD. However, little is known about the recent prevalence of CVD risk factors from large-scale national representative surveys in China within the recent 5 years. Therefore, the 2011–12 China Health and Retirement Longitudinal Study (CHARLS) is to provide the most recent nationwide estimates of CVD risk factors.

2. Methods

To ensure the adoption of best practices and international comparability of results, CHARLS was harmonized with leading international research studies in the U.S. Health and Retirement Study (HRS) model. The Medical Ethics Committee of Peking University granted the current study exemption from review and written informed consent was obtained from all participants prior to data collection.

The detailed sampling design has been published previously [13,14]. Briefly, the CHARLS used multistage probability sampling method to select a representative of people aged 45 and over in China. In the first stage, all county-level units were stratified by region and within region by urban districts or rural counties (The urban–rural definition here and thereafter is based on the China National Bureau of Statistics definition where primary sampling units are defined as urban if they are located in a city, suburb of a city, a town, suburb of a town, or other special areas where nonfarm employment constitutes at least 70% of the work force, such as a special economic zone and state-owned farm

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enterprise) and per capita statistics on gross domestic product (GDP), 150 county-level units within 28 provinces were randomly selected with a probability-proportional-to-size (PPS) sampling technique. In the second stage, neighborhoods (shequ or juweihui) in urban areas and administrative villages (cun) in rural areas were used as primary sampling units (PSUs), which were the lowest level of government organization; and 3 PSUs within each county-level unit were selected using PPS sampling. In the third stage, all of the dwellings in each selected primary sampling unit were selected from the frame that constructed based on maps prepared by a mapping/listing software named CHARLS-GIS on Google Earth maps with the support of local informants. Finally, one resident aged 45 years in each sampled household within each PSU was randomly selected as a participant in the survey. If the chosen household had more than one age-eligible member, one such member was randomly selected, and his or her spouse who was also aged 45 years was also included in the survey. All stages of the sampling were conducted by a computer to avoid human manipulation.

The CHARLS is a nationally representative longitudinal survey of persons in China 45 years of age or older, obtaining information on demographic background, health status and functioning, health care and insurance, work, retirement and pension. The interviewers were trained at Peking University by CHARLS staff members, and the interviews took place in respondents' households using a face-to-face computer-assisted personal interview (CAPI) technology. The interviewers also carried equipment to measure the health functioning and performance in respondents' homes. After completing the household interviews, respondents were invited to a local office of the China Center for Disease Prevention and Control (CDC) or to township hospitals, where trained nurses drew 8-mL samples of fasting blood. The CHARLS survey was conducted from May 2011 to March 2012 in China 28 provinces. Overall, out of the total estimated number (12,740) of age-eligible households, CAPI interviews were conducted on a total of 17,708 individuals aged 45 years living in 10,287 households with the overall response rate of 80%. Among all study participants, 13,978 individuals (78.9%) provided anthropometric and physical performance measures. The target sample for taking blood samples was the entire group of 17,708 main respondents and spouses from the main CHARLS national baseline. Out of this, we collected blood samples for 11,847 individuals, a response rate of 67% (women 69% versus men 65%) [13–15].

Data collection was conducted in examination centers at local health stations or community clinics in the participants' residential area by trained staff according to a standard protocol [14]. Height was measured using the SecaTM213 stadiometer (Manufacturer: Seca Trading Co., LTD., Hangzhou, China). The respondent removes the shoes and stands erect on the floor board of the stadiometer with the back to the vertical backboard of the stadiometer. Weight was measured by the OmronTM HN-286 scale (Manufacturer: Krell Precision Co. LTD., Yangzhou, China). Respondents were instructed to remove their shoes, any bulky clothing and heavy objects from their pockets. An appropriate spot to place the scale, preferably a non-carpeted area, was identified. Blood pressure was measured on the respondent's left arm three times at 45-s intervals by an Omron™ HEM-7112 Monitor (Manufacturer: Omron Co., LTD., Dalian, China). Respondents were instructed to sit down with both feet on the floor and their left arm comfortably supported with the palm facing up. Respondents were asked to roll their sleeve up unless they had on a short sleeve shirt or a thin shirt. The cuff was adjusted to the respondent's arm ensuring that it made direct contact with the skin, the bottom of the cuff was approximately half an inch above the elbow and the air tube ran down the middle of the respondent's arm.

Three tubes of overnight fasting blood specimens were collected from each respondent by medically-trained staff from the China CDC at centralized locations, based on a standard protocol [14,15]. First, a 2 mL tube of blood, was used for a complete blood count (CBC) test, which was performed at county CDC stations or town/village health centers. Second, a 4 mL tube of whole blood was processed and divided into plasma and buffy coat within the same timeframe as the CBC measurement (the CBC was measured within 141 min of collection and the median time from collection to CBC assay was 97 min) and during shipment at 4 °C. After that, the plasma was stored in three 0.5 mL cryovials and the buffy coat in a separate cryovial, which were immediately stored frozen at −20 °C and then transported to the China CDC in Beijing within 2 weeks where they were placed at −80 °C in a deep freezer until an assay at a CMU laboratory. Finally, a 2 mL tube of whole blood that collected for the HbA1c assay was stored immediately and during shipment at 4 °C, and then transported to the Chinese CDC in Beijing within two weeks, where it was placed in a deep freezer and stored at −80 °C for the HbA1c assay.

The study measured glucose, glycosylated hemoglobin (HbA1c), and a lipid panel (total, HDL, LDL cholesterol, and triglycerides) from frozen plasma or whole blood samples, which assays were performed at the Youanmen Center for Clinical Laboratory of Capital Medical University that has regular external quality assessment organized by the Chinese Ministry of Health. The assay method of HbA1c, glucose and a lipid panel (total, HDL, LDL cholesterol, and triglycerides) was Boronate affinity HPLC, and Enzymatic colormetric test, respectively; the coefficient of variation (CV) of within-assay was 1.90%, 0.90%, and 0.80%, 1.00%, 0.70%, 1.50%, respectively; the CV of between-assay was 2.10%, 1.80%, and 1.70%, 1.30%, 1.20%, 1.80%, respectively; the detection limits were 0–40%, 2-450 mg/dL, and 3-800 mg/dL, 3-120 mg/dL, 3-400 mg/dL, 4-1000 mg/dL, respectively [15].

Body-mass index (BMI) was calculated as weight (kg) divided by the square of height (m). A BMI of 25–30 kg/m^2 was defined as overweight, and a BMI of ≥30 kg/m^2 was considered obese [16]. Diabetes was defined as fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) or HbA1c concentration of 6.5% or more or a self-reported insulin or oral hypoglycemic treatment for diabetes [17]. Hypertension was defined as the mean systolic blood pressure (SBP) ≥140 mm Hg and/or the mean diastolic blood pressure (DBP) ≥90 mm Hg and/or self-reported current treatment for hypertension with antihypertensive medication [18]. Dyslipidemia was defined as a total cholesterol concentration ≥200 mg/dL (5.2 mmol/L), or serum triglyceride (TG) level of ≥150 mg/dL (1.7 mmol/L), or low-density lipoprotein cholesterol (LDL-C) of ≥130 mg/dL (3.4 mmol/L), or high-density lipoprotein cholesterol (HDL-C) level of <35 mg/dL (0.9 mmol/L) in males, or HDL-C level of <40 mg/dL (1.0 mmol/L) in females, or self-reported current treatment with cholesterol-lowering medication. Current smoking was defined as having smoked at least 100 cigarettes in one's lifetime and currently smoking cigarettes.

Our study was designed to provide accurate estimates of prevalence of major CVD risk factors according to age, sex, urban or rural residence. All calculations were weighted to represent the overall Chinese adult population aged 45 years or older on the basis of 2010 China population census data [19]. Weight coefficients were derived from the China population census data, the complex survey design and the non-response rate of the current survey to obtain national estimates; and for the analysis of individual biomarkers, a different set of weights were needed because just over 20% did not get biomarkers taken, so we did the same type of inverse probability weighting adjustment [15,20]. The age-standardized prevalences were also calculated with the use of data on the population distribution in China in 2010 [19]. Standard errors were calculated with the Taylor-linearization method appropriate to the complex survey design. The PROC SURVEYFREQ procedure was applied to obtain the prevalence of major CVD risk factors overall and within subgroups. Differences of categorical and continuous variables were tested with PROC SURVEYLOGISTIC and PROC SURVEYREG with adjustment for age, respectively, and the PROC SURVEYLOGISTICS was applied to test for trends across subgroups. P-values were two-sided and P-values < 0.05 were considered significant. All data analyses involved use of the SAS system, version 9.1 (SAS Institute Inc.).

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