

# Ideal Cardiovascular Health and Incidence of Carotid Plaque among Middle-Aged and Elderly Adults

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*Background:* The ideal cardiovascular health (CVH) has been reported to be associated with reduced risk of ischemic stroke (IS). Atherosclerosis is a fundamental precursor in progression to IS. This study aimed to investigate the association of CVH score and atherosclerosis defined by carotid plaque in a community-based cohort. *Methods:* Data came from the Asymptomatic Polyvascular Abnormalities Community study. After exclusions for missing data and original carotid plaque, 1938 subjects were included. At baseline (2010), the 7 CVH factors were quantified on a 14-point scale with 2 points awarded for ideal status, 1 point for intermediate, and 0 point for poor. The incidence of carotid plaque from 2010 to 2012 was evaluated from bilateral common, internal, and external carotid arteries, and carotid bifurcations using high-resolution B-mode ultrasounds. Multivariable logistic models were used to assess the association between CVH score and carotid plaque incidence. *Results:* After 2 years' follow-up, 350 (18.06%) subjects developed carotid plaque. After adjusting for age, sex, education, and income, we observed a significant inverse association between the CVH score and incident carotid plaque. For every CVH score increase, the risk of carotid plaque incidence decreased by 8.10%. Stratified analysis showed the above association had no difference between sexes and age. *Conclusions:* Chinese subjects with a higher CVH score had a lower risk of developing carotid plaque after 2 years. The ideal CVH concept should be further promoted for protecting the arteries from atherosclerosis. **Key Words:** American Heart Association—atherosclerosis—ischemic stroke—carotid plaque—risk. © 2017 Published by Elsevier Inc. on behalf of National Stroke Association.

## Introduction

In 2010, the American Heart Association (AHA) proposed 4 ideal health behaviors (nonsmoking, body mass index [BMI], physical activity, diet) and 3 ideal health factors (total cholesterol,<sup>1</sup> blood pressure [BP], fasting blood

glucose).<sup>2</sup> The ideal cardiovascular health (CVH) concept aimed to improve the CVH of all Americans by 20% while reducing deaths from cardiovascular diseases (CVDs) and stroke by 20%.<sup>2</sup> A series of later studies demonstrated that a greater number of CVH metrics were associated with a lower risk of CVD and mortality.<sup>3</sup> One of our studies also established an inverse association between ideal CVH metrics and incidence of ischemic stroke (IS).<sup>4</sup> However, few studies have investigated the impact of ideal CVH metrics on potential mediators of this association. As a fundamental precursor of CVDs, atherosclerosis is the main mediator in progression to IS. The primordial stroke prevention focuses on preventing the occurrence of atherosclerosis rather than on preventing the incidence of stroke.<sup>5</sup> We therefore investigated the association of CVH score and atherosclerosis defined by carotid plaque in a community-based cohort consisting of middle-aged and elderly adults.

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## Materials and Methods

### Study Population

The Asymptomatic Polyvascular Abnormalities Community (APAC) study is a community-based, prospective, cohort study aimed at investigating the epidemiology of asymptomatic intracranial atherosclerotic stenosis, carotid atherosclerosis, and peripheral artery diseases in Chinese adults. Its design and methods have been previously described.<sup>6</sup> Briefly, a total of 5440 subjects aged 40 years or older and free of stroke, transient ischemic attack, or coronary disease were sampled from the participants of the Kailuan study<sup>7</sup> in 2010. They underwent questionnaire assessment, clinical examination, and laboratory assessment at baseline and updated their health status every 2 years. In the current study, we excluded 2944 subjects who had carotid plaque at baseline, then we excluded 558 subjects without complete data on CVH factors, leaving 847 men and 1091 women. The APAC study complied with the Declaration of Helsinki and was approved by the Ethics Committees of the Kailuan General Hospital and Beijing Tiantan Hospital. All participants provided written informed consent.

### Assessment of CVH Score

A total of 7 CVH metrics were collected according to the AHA guidelines.<sup>2</sup> Each metric is classified into 3 CVH categories: ideal, intermediate, and poor. Subjects of the poor category were assigned a score of 0, those in the intermediate category were assigned a score of 1, and those in the ideal category were assigned a score of 2. Thus, the CVH score of one person could vary from a minimum of 0 to a maximum of 14. The poor, intermediate, and ideal definitions of the 7 health metrics in adults are shown in Table 1. Specially, definitions for the physical activity and diet were modified appropriately in the current study.

Data on smoking, diet, and physical activity were collected through questionnaires. Ideal smoking status was defined as on-smoker or quit more than 12 months. Ideal diet status, mainly based on salt intake, was defined as a consumption of less than 6 g/d. Ideal physical activity

was defined as moderate or vigorous physical activity for 80 min/w or more.

Data on BMI and BP were collected through clinical examination. Height and weight were measured in the standing position, without heavy clothing. BMI was calculated as body weight (kilogram) divided by the square of height (square meter). BMI was defined as ideal if it was less than 25 kg/m<sup>2</sup>. BP was measured twice in the seated position using a mercury sphygmomanometer. The average of the 2 readings was used for the analyses. BP was defined as ideal if it was lower than 120/80 mm Hg without medication.

Blood samples were collected in the morning after fasting overnight and analyzed at the central laboratory of the Kailuan General Hospital. TC was defined as ideal if it was less than 200 mg/dL without medication. Fasting blood glucose was defined as ideal if it was less than 100 mg/dL without medication.

### Assessment of Carotid Plaque

The presence of carotid plaque was evaluated by certified sonographers using high-resolution B-mode ultrasounds (Philips iU-22 ultrasound system, Philips Medical Systems, Bothell, WA).<sup>8</sup> Bilateral carotid arteries were examined, including the common carotid artery (CCA), carotid bifurcation, internal carotid artery (ICA), and external carotid artery. Based on the Mannheim carotid intima-media thickness (IMT) and plaque consensus,<sup>9</sup> carotid plaque was defined as a focal structure encroaching into the arterial lumen of at least .5 mm, or 50% of the surrounding IMT value, or a thickness that is more than 1.5 mm as measured from the media–adventitia interface to the intima–lumen interface. The examination results were reviewed by 2 operators, and the final evaluations were resolved by consensus.

### Statistical Analyses

Mean  $\pm$  standard deviation was used for describing continuous variables, and frequencies and percentages for categorical variables. Subjects were divided into 3 groups

**Table 1.** Poor, intermediate, and ideal definitions: health metrics in adults for the current study

Metric	Poor	Intermediate	Ideal
Smoking	Current smoker	Former smoker or quit $\leq$ 12 months	Nonsmoker or quit $>$ 12 months
Body mass index	$\geq$ 30 kg/m <sup>2</sup>	25-29.9 kg/m <sup>2</sup>	$<$ 25 kg/m <sup>2</sup>
Physical activity	None	1-79 min moderate or vigorous activity every week	$\geq$ 80 min moderate or vigorous activity every week
Diet	$\geq$ 10 g salt intake every day	6-10 g salt intake every day	$<$ 6 g salt intake every day
Total cholesterol	$\geq$ 240 mg/dL	200-239 mg/dL or treated to goal	$<$ 200 mg/dL without medication
Blood pressure	$\geq$ 140/90 mm Hg	120-139/80-89 mm Hg or treated to goal	$<$ 120/80 mm Hg without medication
Fasting blood glucose	$\geq$ 126 mg/dL	100-125 mg/dL or treated to goal	$<$ 100 mg/dL without medication

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