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# The association between epicardial fat thickness and coronary artery calcification according to blood pressure status in nonhypertensive individuals: From the CAESAR study

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**BACKGROUND:** Epicardial adipose tissue represents visceral adiposity, and the coronary artery calcium (CAC) score (CACS) has been suggested as a reasonable surrogate for coronary atherosclerosis. Epicardial fat thickness (EFT) and blood pressure status can be attributed to coronary artery calcification.

**OBJECTIVE:** The present study was performed to evaluate the association between EFT and coronary artery calcification according to blood pressure status in nonhypertensive individuals.

**METHODS:** The CACS and echocardiographic EFT measurement were performed in a total of 1878 nonhypertensive individuals (1535 men; mean age, 44 ± 8.3 years). Subjects were divided into quartiles according to EFT (≤2.575, 2.576–3.168, 3.169–3.900, and >3.900 mm) and into 2 groups according to the presence of CAC. Additionally, individuals were classified as normotensive (n = 1064) or prehypertensive (n = 814).

**RESULTS:** The prevalence of CACS >0 group in prehypertensive individuals was 6.1%, 18.1%, 22.6%, and 29.9% in the lowest, second, third, and highest EFT quartiles, respectively ($P < .001$) and 7.3%, 13.1%, 14.0%, and 13.9% in the normotensive group ($P = .050$). On multivariate regression analysis, the second, third, and highest quartile EFT groups had higher odds ratios for the presence of CAC than that of the lowest quartile (odds ratio [95% confidence interval], 3.849 [1.215–12.194], 4.069 [1.235–13.412], and 4.383 [1.385–13.875], respectively), although only in prehypertensive individuals. Moreover, an increased absolute EFT level was also associated with increased CACS in prehypertensive individuals (standardized β = 0.101, $P = .035$).

T.H.L. and M.S.S. contributed equally to the work reported, and both should be considered as the first authors.

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**CONCLUSION:** This study showed an independent relationship between EFT and coronary artery calcification in nonhypertensive individuals, with variable differences in this association according to blood pressure status.


## Introduction

Epicardial adipose tissue (EAT) located between the myocardium and visceral pericardium is not merely a passive lipid-storage unit, but is an active endocrine organ that can affect the heart and coronary arteries through vasocrine or paracrine secretion of proinflammatory cytokines.[1] EAT represents visceral adiposity, the early detection of which could be helpful for assessing subclinical target organ damage.

EAT, as measured using either echocardiography or computed tomography (CT), has been associated with the presence and severity of coronary artery disease (CAD) in a number of studies.[2–8] Recently, echocardiographic measurement of epicardial fat thickness (EFT) has been proposed as an easy and reliable method for evaluating EAT.[9,10]

Coronary artery calcification is a subclinical cardiovascular disease marker that is associated with worse clinical outcomes in both the general population and patients undergoing coronary revascularization.[11,12] As a result, measurement of the coronary artery calcium (CAC) score (CACS) may be helpful for cardiovascular risk assessment in asymptomatic patients.[13,14]

Few studies have examined the relationship between echocardiographic EFT and CACS[15,16] and were limited by relatively small sample sizes in non-Asian populations that have included hypertensive subjects. Thus, the aim of the present study was to investigate the association between EFT and coronary artery calcification according to blood pressure status in nonhypertensive Korean individuals.

## Material and methods

### Study population

The CArdiometabolic risk, Epicardial fat, and Subclinical Atherosclerosis Registry (CAESAR) study was designed to assess the relationship between cardiovascular risk, CACS, and epicardial fat in 2299 individuals who visited Kangbuk Samsung Health Promotion Center between 2010 and 2011 and who received nonenhanced CT and echocardiogram at baseline with follow-up every 3 to 5 years. Among the total population enrolled in the CAESAR study, baseline data of 1878 individuals (1535 men; mean age, 44 ± 8.3 years) without hypertension were included in this analysis.

Past medical history, medications, alcohol consumption (3 or more times per week), and smoking status (current smoker or nonsmoker) were assessed using standardized questionnaires. Height and weight were measured using automated instruments with participants wearing light clothing and no shoes. Body mass index (BMI) was calculated as weight (kilograms) divided by height (meters squared). Waist circumference was measured at the midpoint between the lowest rib and the iliac crest with the subject standing and breathing normally. Systolic and diastolic blood pressures (SBP and DBP) and heart rate were measured on the right arm by a trained nurse using a mercury sphygmomanometer, with subjects in a seated position after resting for 5 minutes or longer.

A morning blood sample was collected after at least 12 hours of fasting. Serum glucose, total cholesterol, triglycerides (TGs), low-density lipoprotein (LDL) cholesterol (LDL-C), and high-density lipoprotein (HDL) cholesterol concentrations were measured using an autoanalyzer (Advia 1650 Autoanalyzer; Bayer Diagnostics, Leverkusen, Germany). Serum hemoglobin A1c (HbA1c) was measured using an immunoturbidimetric assay with a Cobra Integra 800 automatic analyzer (Roche Diagnostics, Basel, Switzerland) with a reference range of 4.4% to 6.4%. Serum creatinine was measured using the Jaffe reaction method (Advia 1650 kit, Bayer, Pittsburgh, PA) and serum uric acid was measured by enzymatic colorimetric method using an automated clinical chemistry analyzer (Modular DPP analyzers, Roche Diagnostics, Tokyo, Japan).

High-sensitivity C-reactive protein (hsCRP) concentration was measured using particle-enhanced immunonephelometry, with a lower limit of detection of 0.175 mg/L after a 1:20 sample dilution (Behring Nephelometer II; Dade Behring, Marburg, Germany).

Normotension was defined as a SBP less than 120 mm Hg and a DBP less than 80 mm Hg, and prehypertension was defined as a SBP between 120 and 139 mm Hg or a DBP between 80 and 89 mm Hg. Hypertension was defined as current use of antihypertensive medications or known but untreated blood pressure greater than 140/90 mm Hg. Diabetes mellitus was defined as a fasting blood glucose of 7.0 mmol/L (126 mg/dL) or greater, HbA1c of 6.5% or greater, or current use of medication for diabetes.

### Measurement of echocardiographic EFT

Two-dimensional transthoracic echocardiography with a 4-MHz, sector-type transducer probe was performed on