

## Original Contribution

# The association between dietary cholesterol intake and subclinical atherosclerosis in Korean adults: The Kangbuk Samsung Health Study

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**KEYWORDS:**

Subclinical atherosclerosis;  
Coronary artery calcification;  
Dietary cholesterol;  
Low-density lipoprotein cholesterol

**BACKGROUND:** The Scientific Report of the Dietary Guidelines Advisory Committee (2015) concluded that restriction of dietary cholesterol is unnecessary in most adults for the prevention of cardiovascular disease.

**OBJECTIVE:** We aimed to assess the risk for subclinical atherosclerosis according to coronary artery calcium score (CACS), based on dietary cholesterol intake in apparently healthy Korean adults.

**METHODS:** This was a cross-sectional study performed in 30,068 participants (mean age 40.8 years; 84.5% men) in a health screening program in Korea. The data were collected from 2001 to 2013 and analyzed in 2015. Total energy intake and dietary cholesterol intake were assessed with a food frequency questionnaire. The participants were stratified according to quartile of dietary cholesterol intake. CACS was measured by multi-detector computed tomography. Lipid profiles were measured, and the participants were divided into 6 groups according to low-density lipoprotein cholesterol (LDL-C) level: <70, 70 to 99, 100 to 129, 130 to 159, 160 to 189, and  $\geq 190$  mg/dL.

**RESULTS:** The presence of coronary artery calcification was defined as CACS>0. Dietary cholesterol intake did not correlate with mean value of serum LDL-C level. For both genders, the odds ratio for coronary artery calcification was not significantly greater with greater amounts of dietary cholesterol (as assessed by quartile). The risk for coronary artery calcification was not higher in subjects with

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Submitted July 3, 2016. Accepted for publication January 31, 2017.

LDL-C 70–129 mg/dL compared with those with LDL-C < 70 mg/dL; however, the risk was significantly greater in subjects with LDL-C  $\geq$  130 mg/dL compared with those with LDL-C < 70 mg/dL.

**CONCLUSIONS:** Dietary cholesterol intake did not have an association with LDL-C level or with risk for coronary artery calcification in apparently healthy Korean adults. The results have to be translated with consideration of limitation of population-based studies.

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## Introduction

Lowering low-density lipoprotein cholesterol (LDL-C) has been the primary target of numerous clinical trials of lipid-lowering therapy for decades because high LDL-C is a well-known risk factor for development of cardiovascular events.<sup>1–3</sup> Cholesterol is a lipid molecule that is biosynthesized by all animal cells because it is an essential structural component of all animal cell membranes and is required to maintain both membrane structural integrity and fluidity.<sup>4</sup> It is known that the biosynthesis of cholesterol is directly regulated by the cholesterol levels in the body.<sup>5</sup> The plasma cholesterol response to dietary cholesterol is highly variable across and within animal species and between individuals.<sup>6</sup> The relationship between dietary cholesterol and coronary heart disease (CHD) has been a topic of intense research and considerable debate for a good part of the 20th century. Based on several pieces of evidence, a number of organizations recommend restricting dietary cholesterol levels in an effort to reduce plasma cholesterol levels and CHD risk.<sup>7–9</sup>

The Scientific Report of 2015 Dietary Guidelines Advisory Committee (DGAC) in the United States concluded that “Cholesterol is not a nutrient of concern for overconsumption,” suggesting that there no longer be a recommended upper limit for dietary cholesterol intake.<sup>10</sup> This is in contrast to dietary guidelines that have been published for decades that recommended that the upper limit for dietary cholesterol be 300 mg/d.<sup>8,9</sup> However, the DGAC drew on more recently understood nutritional science that dietary cholesterol or “exogenous” cholesterol accounts for approximately one-third of pooled body cholesterol, and the remaining two-thirds is synthesized in the body (endogenous cholesterol).<sup>11</sup> In addition, increased cholesterol intake from the diet, especially eggs, has repeatedly been shown not to increase the circulating cholesterol levels in our body or cardiovascular disease (CVD) risk.<sup>12,13</sup> Given this new evidence, the committee decided to lift the restriction for dietary cholesterol in the American diet. Although dietary pattern of Koreans differ from those of Caucasians, recently published cholesterol guidelines in Koreans recommend restricting daily dietary cholesterol intake to <300 mg.<sup>14</sup> However, it is unknown whether the lifting of the restriction of cholesterol intake, as though in DGAC guideline, is needed in Asian populations and, specifically, if differences in dietary cholesterol intake are associated with differences in the risk of CVD in Asian populations.

Therefore, in this study, we stratified a cohort of apparently healthy Korean adults without underlying CVD by dietary cholesterol intake and evaluated their risk for subclinical atherosclerosis assessed with coronary artery calcium score (CACS). In addition, we analyzed whether dietary cholesterol intake correlates with blood cholesterol levels.

## Materials and methods

### Study subjects

The study population consisted of individuals who participated in a comprehensive health screening program with a Food Frequency Questionnaire (FFQ) and underwent a comprehensive health examination including measurement of lipid profiles and cardiac computed tomography (CT) for CACS at Kangbuk Samsung Hospital, Seoul, Korea, between 2011 and 2013 ( $N = 47,292$ ). The purpose of the screening program was to promote health through early detection of chronic diseases and risk factors. In addition, the Korean Industrial Safety and Health Law requires working individuals to participate in an annual or biennial health examination. Participants were employees or spouses of companies or local governmental organizations who registered individually for the program. For this analysis, subjects were excluded for 1 or more of the following reasons: history of definite CVD or cerebrovascular diseases ( $n = 651$ ), history of malignancy ( $n = 1171$ ), currently taking lipid medication ( $n = 1927$ ), missing data for energy intake or lipid profiles ( $n = 9123$ ), and missing data for smoking, alcohol, or exercise ( $n = 7605$ ). Finally, a total of 30,068 subjects were included in this analysis.

This study was approved by the Institutional Review Board of Kangbuk Samsung Hospital, which exempted the requirement for informed consent, as we only retrospectively accessed de-identified data.

### Anthropometric and laboratory measurements

All examinations were conducted at the Kangbuk Samsung Health Screening Center clinics in Seoul and Suwon by trained personnel following a standardized protocol. A self-administered questionnaire was used to collect information about sociodemographic characteristics, lifestyle factors, past medical history, family history, and medication use. Details regarding alcohol use included the frequency of intake per week and the average amount of intake per episode.

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