International Journal of Cardiology xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Prevalence and severity of coronary artery calcification based on the epidemiologic pattern: A propensity matched comparison of asymptomatic Korean and Chinese adults☆

Donghee Han [a,c,1], Yang Gao [b,1], Bríain ó Hartaigh [c], Heidi Gransar [d], Ji Hyun Lee [a,c], Asim Rizvi [c], Su-Yeon Choi [e], Eun Ju Chun [f], Jidong Sung [g], Hae-Won Han [h], Sung Hak Park [i], James K. Min [c], Bin Lu [b,*], Hyuk-Jae Chang [a,**]

[a] Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University Health System, Seoul, Republic of Korea
[b] Department of Radiologic Imaging, Fuwai Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, National Center of Cardiovascular Diseases, Beijing, China
[c] Dalio Institute of Cardiovascular Imaging, New York-Presbyterian Hospital and the Weill Cornell Medical College, New York, NY, USA
[d] Department of Imaging, Cedars Sinai Medical Center, Los Angeles, CA, USA
[e] Division of Cardiology, Seoul National University Healthcare System Gangnam Center, Seoul National University College of Medicine, Seoul, Republic of Korea
[f] Department of Radiology, Seoul National University Bundang Hospital, Seoul, Republic of Korea
[g] Division of Cardiology, Department of Medicine, Sungkyunkwan University School of Medicine, Heart Stroke & Vascular Institute, Samsung Medical Center, Seoul, Republic of Korea
[h] Department of Internal Medicine, Gangnam Heartscan Clinic, Seoul, Republic of Korea
[i] Department of Radiology, Gangnam Heartscan Clinic, Seoul, Republic of Korea

ARTICLE INFO

Article history:
Received 14 August 2016
Received in revised form 23 November 2016
Accepted 17 December 2016
Available online xxxx

Keywords:
Coronary artery calcium score
East Asian
Risk factors
Coronary artery disease
Epidemiology

ABSTRACT

Background: Lifestyle, environmental, and genetic factors substantially influence cardiovascular disease (CVD) risk. We aimed to explore epidemiologic trends in coronary artery calcium scores (CACS), as a marker of CVD, along with possible differences by geographic area and study period in separate East Asian populations.
Methods: We generated 3 matched groups (n = 702) using a propensity scoring approach derived from a Korean (N = 48,901) and Chinese cohort (N = 927) as follows: (1) A recent Chinese group and (2) recent Korean group, both of whom underwent CACS scanning from 2012–2014; and (3) a past Korean group who underwent CACS scanning 8–10 years before the index group (2002–2006). We used logistic regression to generate odds ratios (OR) with 95% confidence intervals (95% CI) to estimate the likelihood of having CACS between the groups, based on CACS stratified by severity: >0 (any), >100 (moderate), and >400 (severe).
Results: The prevalence of any, moderate, or severe CACS did not differ significantly between the recent Chinese and Korean groups. Notably, the odds of the presence of moderate CACS in the recent Chinese group (OR: 3.05, 95% CI: 1.49–6.71, P-value < 0.001) and the presence of any CACS in the recent Korean group (OR: 1.58, 95% CI: 1.17–2.15, P-value < 0.001) were significantly higher than in the past Korean group.
Conclusions: In this study involving separate East Asian populations, there were no geographic differences in the prevalence of CACS. However, changes in other unmeasured factors over time are likely the culprits for the elevated prevalence of CACS in asymptomatic East Asians.

1. Introduction

Cardiovascular disease (CVD) is a global culprit of morbidity and mortality [1]. The prevalence and severity of CVD is often influenced by a myriad of conventional CVD risk factors that are largely responsible for the development and progression of CVD. To this end, non-modifiable factors such as age and gender, as well as race and ethnicity, substantially impact the risk of experiencing CVD [2,3]. Recently, there has also been a rise in the presence of numerous other lifestyle, environmental, and genetic components known to heighten CVD risk – particularly in newly industrialized nations, beyond western societies [4–7]. A few prior reports have documented the clinical utility of the coronary

☆ All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

* Correspondence to: Bin Lu, Department of Radiologic Imaging, Fuwai Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, National Center of Cardiovascular Diseases, 167 Beilishi Road, Beijing 100037, China.
** Correspondence to: Hyuk-Jae Chang, Division of Cardiology, Yonsei Cardiovascular Center, Yonsei University Health System, 50 Yonsei-ro, Seodaemun-gu, Seoul 03722, Republic of Korea.
E-mail addresses: blu@vip.sina.com (B. Lu), hjchang@yuhs.ac (H.-J. Chang).
[1] Share equal contribution to this manuscript.

http://dx.doi.org/10.1016/j.ijcard.2016.12.106
0167-5273/

artery calcium score (CACS) as a robust indicator of the prevalence and severity of CVD among asymptomatic Asian adults [8,9].

In spite of these observations, however, potential differences in the prevalence and severity of CACS among various East Asian populations have not been fully elucidated. Furthermore, given the rapid demographic shifts and growing urbanization of post-industrialized Asian countries, the assessment of any disparities in the prevalence and severity of CACS, and the general patterns over time have not been firmly established to date. Underlining epidemiologic trends in the prevalence and severity of CACS across diverse East Asian populations may serve a crucial role by informing public health initiatives designed to prevent the onset of future CVD.

We therefore set forth to explore the epidemiologic pattern of CACS as a proxy indicator for CVD, while accounting for multiple conventional risk factors via propensity score matching techniques. Specifically, general comparisons, along with possible changes in the prevalence of CACS according to study time-period, were assessed among separate East Asian cohorts derived from Korea (i.e., 2002–2006 and 2012–2014) and China (i.e., 2012–2014).

2. Methods

2.1. Study population

The current investigation employed two separate study cohorts that consisted of asymptomatic Korean and Chinese adults. Information regarding the Korean population was derived from the Korea Initiatives on Coronary Artery calcification (KOICA) registry. Details of the rationale and design of the KOICA registry have been described previously [10]. Briefly, the KOICA registry is a retrospective, observational registry included 48,901 single-ethnicity, asymptomatic, self-referred individuals who underwent a health examination at 1 of 3 participating healthcare centers between December 2002 and July 2014 (Severance Check-up Healthcare Center, Seoul National University Healthcare System Gangnam Center, or Samsung Medical Center, Seoul, South Korea). The Chinese study sample enrolled a total of 928 subjects that were representative of two communities and who underwent a health examination at FuWai Hospital in Beijing between September 2012 and May 2013. The Xi-Shan community of Shi-Jing-Shan District was selected by typical sampling. The neighborhood committee generated a list of all the male residents aged 35–74 years and female residents aged 40–74 years. The appropriate institutional review board committees approved the study protocol at each site.

2.2. Clinical risk factors

Self-reporting medical questionnaires were administered to gather information regarding conventional risk factors and past medical history in both cohorts. Hypertension was defined as a history of being diagnosed with hypertension, or the use of antihypertensive medication. Diabetes mellitus was defined as a history of being diagnosed with diabetes, or the use of anti-glycemic medication. Likewise, dyslipidemia was defined as a history of being diagnosed with dyslipidemia, or reporting the use of medication for dyslipidemia. Cigarette smoking was considered to be present if a subject was an active smoker at the time of screening. The clinical anthropometric parameters collected included age, gender, height, weight, body mass index (BMI), and creatinine level at the time of CACS scanning.

2.3. CACS acquisition

All participants in the Korean cohort underwent CACS scanning using a more than 16-slice CT scanner. Specific CT scanner types used at each center included the Philips Brilliance 256 iCT, Philips Brilliance 40 channel multi-detector CT (Philips Healthcare), Siemens 16-slice Sensation (Siemens Healthcare), and GE 64-slice Lightspeed (GE Healthcare). A calcium scan was performed using standard prospective or retrospective methods with a 225- to 400-millisecond gantry rotation time. The image data were reconstructed using a 2.5 to 3-mm slice thickness. Calcium score analysis was performed using dedicated workstations (AW Volume Share 5 workstation, GE Healthcare; Rapidia 3D, Infinitt Co.; EBW workspace version 3.5, Philips Healthcare) with analysis software (Smart Score 4.0, GE Healthcare; Rapidia3D, Infinitt Co.; HeartBeat CS, Philips Healthcare). In the Chinese cohort, prospective ECG-triggered sequential cardiac multidetector computed tomography (MDCT) scans were performed using a 64-detector row spiral computed tomography scanner (Light-Speed VCT; GE Healthcare) with a 0.35-second rotation time, at 120 kV, and 200 mA. Analyses were done using a stand-alone workstation (Deep Blue, ADW4.3, GE Healthcare). The image data were reconstructed using a 2.5 mm slice thickness. CACS were subsequently calculated for patients in both cohorts using the methods described by Agatston et al. [11].

2.4. Statistical considerations

For the purpose of this study, we generated 3 cohorts from the Korean and Chinese registries: (1) a Chinese cohort (e.g., 2012 to 2014); (2) a recent Korean cohort, who underwent CACS scans during the same time period as the Chinese cohort (e.g., 2012 to 2014); and (3) a past Korean group, who underwent CACS scans between 2002 and 2006. Subjects with a history of coronary artery disease and without an available CACS or clinical risk factors for propensity score matching were excluded. Propensity matching was performed according to the following conventional risk factors: age, gender, hypertension, diabetes, dyslipidemia, and current smoking status. Propensity scores were calculated using a non-parsimonious multiple logistic regression model that was performed separately for gender in an effort to ensure that the covariate balancing property was satisfied. Subsequently, propensity scores were used to match both cohorts using the Mahalanobis nearest-neighbor matching algorithm based on a caliper of 0.001 [12]. After propensity matching, 3 groups of 702 matched pairs were generated (Fig. 1). CACS was categorized as 0, 1–100, 101–400, and >400. In addition, the study population was categorized according to the presence or absence of any CACS (>0), moderate CACS (>100), or severe CACS (>400). Framingham 10-year coronary heart disease risk scores (FRS) were calculated among the groups [13]. Continuous variables are reported as

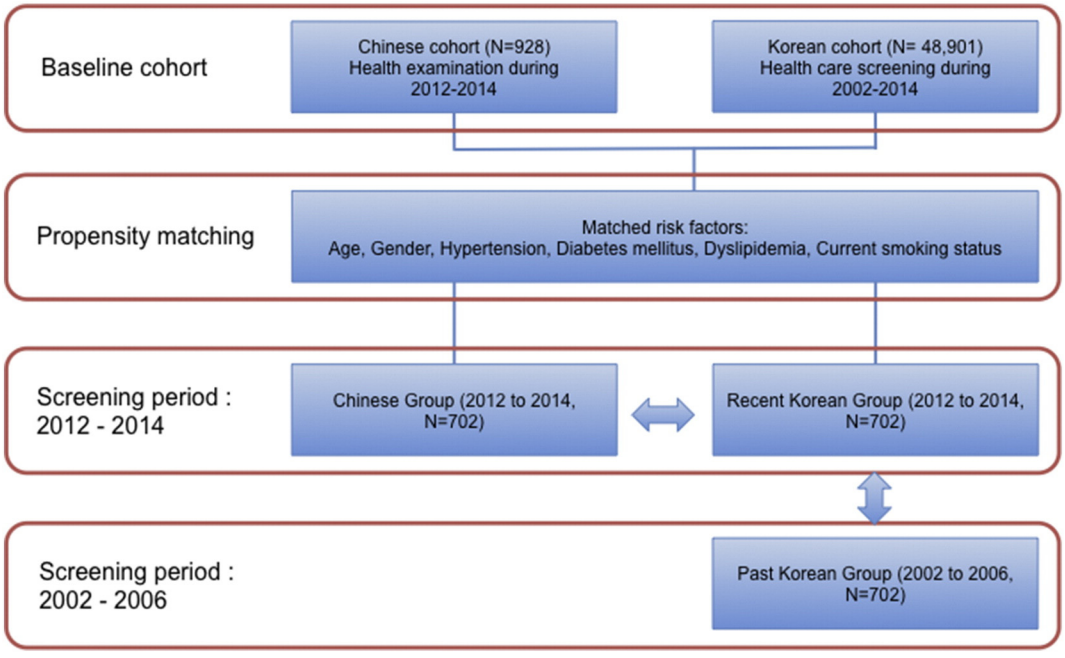

Fig. 1. Study flow chart.

Please cite this article as: D. Han, et al., Prevalence and severity of coronary artery calcification based on the epidemiologic pattern: A propensity matched comparison of as..., Int J Cardiol (2016), http://dx.doi.org/10.1016/j.ijcard.2016.12.106