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Comparability in coronary artery calcium scores on CT scan between two community-based cohort studies

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Coronary artery calcification score (CCS) has been increasingly recognized as an independent predictor for coronary heart disease [1, 2] in multiple ethnic/racial groups.[3] It is important to assess comparability when evaluating CCS and its determinants across various studies, in which a protocol of obtaining CCS may differ. However, study on comparability in such situation is limited.

We compared the CCS per different protocols on the same images. One protocol is adopted in the Multi-Ethnic Study of Atherosclerosis (MESA) and the other in the EBCT and Risk factor Assessment among Japanese and US men in the Post World War II birth cohort (ERA JUMP) study.[4] Detailed methods in both studies were reported elsewhere.[4, 5] In brief, an imaging software automatically identifies a lesion of candidate coronary artery calcification (CAC) on the basis of predefined criteria. Then a reader reviews each candidate lesion to either accept or reject, and scores according to Agatston's method.[6] The criteria of such automated identification are somewhat different between the two protocols. In the former, three criteria need to be met; CT attenuation of 130 Hounsfield Unit (HU), calcified plaque size (4.6 mm³, four-detector row CT; 5.5 mm³, electron-beam CT), and distance from the coronary artery trajectory;[5] whereas in the latter, CAC lesion is considered to be present with 3 contiguous pixels (1 mm²) with attenuation ≥130 HU.[4]

After completion of the ERA JUMP study, we have recruited more participants using the same protocols to extend the study. The study was approved by the Institutional Review Board of Shiga University of Medical Science (17–19, 20–61), and written informed consent was obtained from all participants. For the present report, we sampled the first forty nine participants scanned with EBCT, and the first fifty participants scanned with 16-multislice computed tomography (16MCT). The images were scored by a physician certified for CAC

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scoring at the Cardiovascular Institute, University of Pittsburgh. Then a total of 99 sets of duplicate images were sent to the MESA CT center at Harbor-UCLA. The duplicate images were scored by a MESA-certified physician, following their protocol, who was blind to the original score. Wilcoxon signed-rank sum test was used to assess statistical difference in CCS between the two readings. Intra-class correlation coefficient (ICC) was calculated after log-transforming CCS. Statistical test was two-tailed, and $p < 0.05$ was considered to be significant.

The distribution of the CCS was right-skewed in both readings. The median (inter-quartile range), (minimum-maximum) scores were 81.0 (13.6 to 268.4), (0.0 -3578.9) for the MESA protocol, and 78.7 (13.6 to 256.6), (1.0 - 3564.4) for the ERA-JUMP protocol. There was no statistical difference between CCS readings in pair ($p=0.79$). ICCs [95% confidence interval] were similarly high regardless of either EBCT (0.96 [0.93, 0.98]) or 16MCT (0.95 [0.91, 0.97]). The combined ICC was 0.95 [0.93, 0.97]. Even among a subgroup of participants whose CCS was 0 to 100 ($n=52$), ICC was as high as 0.83 [0.72, 0.90]. The Bland-Altman Plot showed an overall good agreement across the observed CCS level (Figure).

To summarize, in comparison of CCS according to the two protocols, we found an overall good agreement across the CCS level ranging from 0 to 3500 with no evidence of systematic bias. The very high ICCs indicated that within-individual measurement error was very small between the two readings. We conclude that the CCS between the two studies is comparable.

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Figure 1.

Abbreviations: CCS: Coronary artery calcification score; ERA JUMP: the EBCT and Risk factor Assessment among Japanese and US men in the Post World War II birth cohort; MESA: Multi-Ethnic Study of Atherosclerosis