Obesity is a critical cardiovascular risk factor that has been defined in terms of body mass index (BMI), abdominal circumference (AC), and fat area. In this study, we examined which markers of obesity are most closely associated with major adverse cardiovascular events (MACE).

Methods and Results: This prospective cohort study enrolled 529 consecutive patients who initially underwent coronary computed tomography angiography for screening of coronary atherosclerosis at Fukuoka University Hospital (FU-CCTA Registry) and either were clinically suspected of having coronary artery disease (CAD) or had at least 1 cardiovascular risk factor with a follow-up of up to 5 years. Measurements of subcutaneous fat area (SFA), visceral fat area (VFA), and AC were quantified using multidetector row computed tomography. The primary endpoint was MACE. SFA and the SFA to VFA ratio (SFA/VFA) were significantly lower in the MACE than non-MACE group. SFA, AC, BMI, and SFA/VFA were each independently associated with MACE. Receiver operating characteristic curve analysis revealed a greater area under the curve for SFA/VFA than for the other parameters. The cut-off level of SFA/VFA with the greatest sensitivity and specificity for the diagnosis of MACE was 1.45 (sensitivity 0.849, specificity 0.472).

Conclusions: Our results suggest that SFA/VFA may be a marker for evaluating the presence of MACE.

Key Words: Abdominal circumference; Body mass index; Major adverse cardiac events; Subcutaneous fat area; Visceral fat area
MACE and the Subcutaneous: Visceral Fat Area Ratio

underwent MDCT coronary angiography between April 2012 and June 2017. Patients with creatinine >2.0 mg/dL or contrast-induced allergy did not undergo MDCT. The procedures in this study were performed in accordance with the Declaration of Helsinki and the ethical standards of the Independent Review Board of Fukuoka University. The study protocol was approved by the Independent Review Board of Fukuoka University (IRB #09-10-02) and all subjects provided informed consent prior to taking part in the study.

Evaluation of Coronary Arteries Using MDCT

Coronary arteries were evaluated using MDCT:24 266 patients were scanned by 64-MDCT (Aquilion 64; TOSHIBA, Tokyo, Japan) and 263 patients were scanned by 320-MDCT (Aquilion ONE ViSION; TOSHIBA).

Although BMI, AC, SF area (SFA), VFA, the ratio of SFA to VFA (SFA/VFA), and SFA+VFA are all considered markers of obesity, it is not known which markers are most closely associated with cardiovascular events. Therefore, in this study we investigated the associations between the presence of major adverse cardiovascular events (MACE) and BMI, AC, SFA, VFA, SFA/VFA, or SFA+VFA.

Methods

Study Subjects
In all, 529 subjects who were clinically suspected of having CAD or who had at least 1 cardiac risk factor (HTN, DL, DM and smoking) were enrolled in this study. All subjects performed by MDCT and a Ziostation work-

Adipocytes are considered to differentiate from mesenchymal stem cells to preadipocytes, and mature adipocytes can store excess energy as TG. Adipocytes can be classified according to size (small and large), adipose tissue can be classified according to color (white and brown), and fat location can be classified as visceral or subcutaneous (VF and SF, respectively). Many studies have shown that VF has a detrimental effect on metabolism and the risk of CAD.17,18 Excess energy is considered to be converted into neutral fat and is initially stored in SF. The volume of SF is predetermined in each individual, and when the amount that can be allocated to SF is exceeded, the destination changes to VF.20 The best tool for estimating SF and VF is multidetector row computed tomography (MDCT). MDCT has become more widely available in many general hospitals and enables the accurate, non-invasive assessment of coronary artery stenosis,21 calcification,22 and plaque imaging.23

| Table 1. Patient Characteristics | All patients (n=529) | Non-MACE group (n=496) | MACE group (n=33) | P value (non-MACE vs. MACE) |
|----------------------------------|---------------------|------------------------|-------------------|-----------------------------|
| Age (years)                      | 66±11               | 66±11                  | 66±11             | 0.9                         |
| Male sex (%)                     | 51                  | 49                     | 73                | 0.009                        |
| Family history (%)               | 23                  | 23                     | 18                | 0.509                        |
| Smoking (%)                      | 36                  | 35                     | 58                | 0.009                        |
| Hypertension (%)                 | 69                  | 68                     | 79                | 0.194                        |
| SBP (mmHg)                       | 136±19              | 135±19                 | 139±24            | 0.249                        |
| DBP (mmHg)                       | 77±13               | 77±12                  | 76±15             | 0.625                        |
| Diabetes (%)                     | 23                  | 22                     | 36                | 0.061                        |
| HbA1c (%)                        | 6.0±1.1             | 6.0±1.1                | 6.2±1.0           | 0.271                        |
| FBG (mg/dL)                      | 110±34              | 109±34                 | 118±33            | 0.139                        |
| Dyslipidemia (%)                 | 62                  | 62                     | 64                | 0.842                        |
| TG (mg/dL)                       | 135±94              | 136±94                 | 152±105           | 0.287                        |
| HDL-C (mg/dL)                    | 55±15               | 55±15                  | 52±16             | 0.259                        |
| LDL-C (mg/dL)                    | 112±31              | 112±30                 | 110±34            | 0.638                        |
| L/H ratio                        | 2.2±0.8             | 2.2±0.8                | 2.3±1.1           | 0.348                        |
| Non HDL-C (mg/dL)                | 141±39              | 141±39                 | 139±39            | 0.757                        |
| MetS (%)                         | 36                  | 36                     | 46                | 0.249                        |
| CAD (%)                          | 56                  | 54                     | 82                | <0.002                        |
| VD                               | 1.0±1.1             | 1.0±1.1                | 1.8±1.1           | <0.0001                      |
| CACS (AU)                        | 254±683             | 224±586                | 694±1,470         | 0.0001                       |
| Gensini Score (AU)               | 13±16               | 12±13                  | 29±36             | <0.0001                      |

Continuous variables are expressed as mean±SD. *A family history of myocardial infarction, angina pectoris, or sudden death. AU, arbitrary units; CACS, coronary artery calcium score; CAD, coronary artery disease; DBP, diastolic blood pressure; FBG, fasting blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; L/H, LDL-C to HDL-C ratio; MACE, major adverse cardiac events; MetS, metabolic syndrome; non-HDL-C, total cholesterol minus HDL-C; SBP, systolic blood pressure; TG, triglyceride; VD, number of vessels with significant disease.
coronary revascularization, and ischemic stroke. For a diagnosis of MI, the patient had to have shown both evidence of ischemic electrocardiogram changes and elevation of cardiac enzymes. Coronary revascularization was performed if the lesion had significant luminal stenosis (>50% diameter stenosis) in the presence of angina symptoms and/or proven myocardial ischemia in the target vessel. Cardiovascular death was identified during the follow-up period. When patients had significant coronary stenosis as assessed by CCTA and received coronary intervention immediately after CCTA, the intervention was not included in

![Figure 1](image-url)

**Figure 1.** (A) Body mass index (BMI), (B) abdominal circumference (AC), (C) subcutaneous fat area (SFA), (D) visceral fat area (VFA), (E) SFA to VFA ratio (SFA/VFA) and (F) SFA+VFA in the major adverse cardiovascular events (MACE) and non-MACE groups. Data are the mean±SD. AU, arbitrary units.

**Table 2. Medications Used**

| Medication                  | All patients (n=529) | Non-MACE group (n=496) | MACE group (n=33) | P value (non-MACE vs. MACE) |
|-----------------------------|----------------------|------------------------|--------------------|-----------------------------|
| ACEI/ARB (%)                | 40                   | 39                     | 58                 | 0.032                       |
| CCB (%)                     | 39                   | 39                     | 36                 | 0.789                       |
| β-blocker (%)               | 11                   | 11                     | 0                  | 0.139                       |
| Diuretic (%)                | 11                   | 11                     | 15                 | 0.452                       |
| Statin (%)                  | 36                   | 36                     | 39                 | 0.668                       |
| Eicosapentaenoic acid (%)   | 3                    | 3                      | 3                  | 0.903                       |
| Sulfonylurea (%)            | 10                   | 1                      | 24                 | 0.009                       |
| α-glucosidase inhibitor (%) | 3                    | 3                      | 3                  | 0.951                       |
| Biguanide (%)               | 7                    | 7                      | 9                  | 0.662                       |
| Thiazolidinedione (%)       | 2                    | 2                      | 3                  | 0.827                       |
| DPP-4 inhibitor (%)         | 11                   | 11                     | 18                 | 0.201                       |
| Insulin (%)                 | 4                    | 4                      | 3                  | 0.776                       |

Continuous variables are expressed as the mean±SD. ACEI, angiotensin-converting-enzyme inhibitor; ARB, angiotensin II receptor blocker; CCB, calcium channel blocker; DPP-4, dipeptidyl peptidase-4; MACE, major adverse cardiac events.
MACE as coronary revascularization.

**Evaluation of Risk Factors for CAD**

Information was collected for BMI, SBP, DBP, serum total cholesterol (TC), TG, HDL-C, and low-density lipoprotein cholesterol (LDL-C) concentrations, the LDL-C to HDL-C ratio, non-HDL-C (calculated by subtracting HDL-C from TC), uric acid (UA), fasting glucose, HbA1c, smoking status (current vs. non-smokers), family history (MI, angina pectoris, or sudden death), and medication as risk factors in all patients.

BMI was calculated as weight (kg) divided by height squared (m²). Blood pressure was determined as the mean of 2 measurements obtained in an office setting by the conventional cuff method using a mercury sphygmomanometer after at least 5 min rest. All blood samples were drawn in the morning after the patients had fasted overnight. Data regarding a history of HTN, DL, DM, and a history of smoking were obtained from patients’ medical records. Patients who had a current SBP/DBP ≥140/90 mmHg or who were receiving antihypertensive therapy were considered to have HTN. Patients with LDL-C ≥140 mg/dL, TG ≥150 mg/dL, and/or HDL-C <40 mg/dL or who were receiving lipid-lowering therapy were considered to have DL.

DM was defined using the American Diabetes Association criteria or on the basis of patients taking glucose-lowering medication. Hyperuricemia was defined as a serum UA level ≥7.0 mg/dL or the administration of uric acid-lowering drugs.

**Statistical Analysis**

Statistical analyses were performed using SAS ver. 9.4 (SAS Institute, Cary, NC, USA) and Excel 2016 (SSRI, Tokyo, Japan) at Fukuoka University (Fukuoka, Japan). Continuous variables are shown as the mean ± SD. Categorical and continuous variables were compared between groups using Chi-squared analysis and t-tests, respectively. Multivariate logistic regression analysis was used to identify independent variables that were related to the presence or absence of MACE. Receiver operating characteristic (ROC) curve analysis was used to determine cut-off levels of BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA to distinguish between the presence and absence of MACE at the highest

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**Table 3. Predictors of the Presence of MACE**

| Variables | Regression coefficient | Standard error | X² | OR (95% CI) | P value |
|-----------|------------------------|---------------|----|------------|--------|
| **Predictors including BMI in the presence of MACE** | | | | | |
| Age | −0.003 | 0.019 | 0.023 | 0.997 (0.962–1.034) | 0.88 |
| Male sex | 0.712 | 0.474 | 2.316 | 2.057 (0.812–5.211) | 0.128 |
| Family history | −0.208 | 0.480 | 0.187 | 0.813 (0.317–2.081) | 0.665 |
| Smoking | 0.489 | 0.431 | 1.288 | 1.631 (0.701–3.794) | 0.256 |
| Hypertension | 0.087 | 0.547 | 0.025 | 0.991 (0.373–3.189) | 0.873 |
| Diabetes | 0.287 | 0.499 | 0.331 | 1.332 (0.501–3.545) | 0.565 |
| Dyslipidemia | 0.034 | 0.398 | 0.007 | 1.035 (0.474–2.259) | 0.932 |
| BMI | −0.130 | 0.064 | 4.124 | 1.210 (0.899–4.938) | 0.025 |
| ACEI/ARB | 0.772 | 0.448 | 2.965 | 2.063 (0.899–5.206) | 0.085 |
| SU | 0.590 | 0.513 | 1.323 | 1.805 (0.660–4.938) | 0.25 |
| **Predictors including AC in the presence of MACE** | | | | | |
| Age | 4.240 | 0.018 | 0.001 | 1.000 (0.965–1.037) | 0.982 |
| Male sex | 0.698 | 0.471 | 2.200 | 2.010 (0.799–5.056) | 0.138 |
| Family history | −0.194 | 0.480 | 0.164 | 0.823 (0.322–2.108) | 0.686 |
| Smoking | 0.517 | 0.429 | 1.450 | 1.677 (0.723–3.888) | 0.229 |
| Hypertension | 0.129 | 0.549 | 0.055 | 1.137 (0.388–3.335) | 0.815 |
| Diabetes | 0.239 | 0.501 | 0.227 | 1.270 (0.476–3.387) | 0.634 |
| Dyslipidemia | 0.048 | 0.400 | 0.015 | 1.049 (0.479–2.299) | 0.904 |
| AC | −0.045 | 0.022 | 4.132 | 1.058 (0.916–0.998) | 0.042 |
| ACEI/ARB | 0.743 | 0.447 | 2.766 | 2.103 (0.876–5.050) | 0.096 |
| SU | 0.650 | 0.518 | 1.578 | 1.916 (0.695–5.287) | 0.209 |
| **Predictors including SFA in the presence of MACE** | | | | | |
| Age | −0.002 | 0.019 | 0.010 | 0.998 (0.962–1.035) | 0.92 |
| Male sex | 0.312 | 0.491 | 0.402 | 1.366 (0.521–3.579) | 0.526 |
| Family history | −0.149 | 0.481 | 0.096 | 0.862 (0.336–2.211) | 0.757 |
| Smoking | 0.473 | 0.428 | 1.221 | 1.605 (0.693–3.717) | 0.269 |
| Hypertension | 0.108 | 0.548 | 0.039 | 1.114 (0.381–3.259) | 0.844 |
| Diabetes | 0.171 | 0.500 | 0.117 | 1.186 (0.446–3.159) | 0.732 |
| Dyslipidemia | 0.057 | 0.400 | 0.021 | 1.059 (0.483–2.321) | 0.886 |
| SFA | −0.007 | 0.003 | 5.007 | 0.993 (0.987–0.999) | 0.025 |
| ACEI/ARB | 0.760 | 0.449 | 2.873 | 2.139 (0.888–5.153) | 0.09 |
| SU | 0.664 | 0.517 | 1.645 | 1.942 (0.704–5.355) | 0.12 |

(Table 3 continued the next page.)
36% of patients were using angiotensin-converting enzyme inhibitors (ACEI)/angiotensin II receptor blockers (ARB), calcium channel blockers, and statins, respectively. There were significant differences in medications used between the MACE and non-MACE groups, with the use of ARB/ACEI and sulfonylurea (SU) being significantly higher in the MACE group.

BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA in the MACE and Non-MACE Groups

Figure 1 shows BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA in the MACE and non-MACE groups. As can be seen from Figure 1, SFA and SFA/VFA were significantly lower in the MACE than non-MACE group.

Predictors of MACE, Including BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA

We used logistic regression analysis to investigate independent predictors of MACE in all patients (Table 3). We selected conventional coronary risk factors (age, sex, family history, smoking, HTN, DM, and DL), ACEI/ARB, possible sensitivity and specificity levels. Two-sided P<0.05 was considered significant.

| Variables | Regression coefficient | Standard error | χ² | OR (95% CI) | P value |
|-----------|------------------------|----------------|----|-------------|---------|
| Predictors including VFA in the presence of MACE | | | | | |
| Age | 0.005 | 0.018 | 0.089 | 1.005 (0.970–1.042) | 0.765 |
| Male sex | 0.675 | 0.473 | 2.030 | 1.963 (0.776–4.965) | 0.154 |
| Family history* | −0.179 | 0.477 | 0.014 | 0.836 (0.328–2.133) | 0.708 |
| Smoking | 0.539 | 0.428 | 1.586 | 1.715 (0.741–3.970) | 0.208 |
| Hypertension | 0.027 | 0.544 | 0.002 | 1.027 (0.354–2.980) | 0.961 |
| Diabetes | 0.149 | 0.491 | 0.093 | 1.161 (0.444–3.038) | 0.761 |
| Dyslipidemia | −0.077 | 0.407 | 0.036 | 0.926 (0.417–2.056) | 0.85 |
| VFA | −2.660 | 0.003 | 0.006 | 1.000 (0.993–1.006) | 0.937 |
| ACEI/ARB | 0.674 | 0.445 | 2.296 | 1.962 (0.820–4.694) | 0.13 |
| SU | 0.623 | 0.501 | 1.545 | 1.864 (0.898–4.976) | 0.214 |
| Predictors including SFA/VFA in the presence of MACE | | | | | |
| Age | 0.004 | 0.018 | 0.049 | 1.004 (0.968–1.041) | 0.825 |
| Male sex | 0.061 | 0.496 | 0.015 | 1.063 (0.402–2.811) | 0.902 |
| Family history* | −0.135 | 0.482 | 0.078 | 0.874 (0.340–2.247) | 0.78 |
| Smoking | 0.499 | 0.424 | 1.386 | 1.647 (0.718–3.778) | 0.239 |
| Hypertension | −0.009 | 0.554 | 2.629 | 0.991 (0.334–2.937) | 0.987 |
| Diabetes | 0.032 | 0.502 | 0.004 | 1.032 (0.386–2.758) | 0.95 |
| Dyslipidemia | −0.257 | 0.398 | 0.418 | 0.773 (0.354–1.687) | 0.518 |
| SFA/VFA | −0.969 | 0.367 | 6.980 | 0.379 (0.185–0.779) | 0.008 |
| ACEI/ARB | 0.801 | 0.460 | 3.037 | 2.228 (0.905–5.486) | 0.081 |
| SU | 0.654 | 0.515 | 1.612 | 1.923 (0.701–5.279) | 0.204 |
| Predictors including SFA+VFA in the presence of MACE | | | | | |
| Age | 0.001 | 0.018 | 0.002 | 1.001 (0.965–1.037) | 0.967 |
| Male sex | 0.568 | 0.476 | 1.428 | 1.765 (0.695–4.485) | 0.232 |
| Family history* | −0.174 | 0.478 | 0.132 | 0.841 (0.329–2.146) | 0.717 |
| Smoking | 0.509 | 0.429 | 1.409 | 1.664 (0.718–3.86) | 0.235 |
| Hypertension | 0.095 | 0.546 | 0.030 | 1.1 (0.377–3.209) | 0.882 |
| Diabetes | 0.196 | 0.493 | 0.158 | 1.217 (0.463–3.2) | 0.691 |
| Dyslipidemia | 0.049 | 0.405 | 0.015 | 1.051 (0.475–2.323) | 0.903 |
| SFA+VFA | 0.002 | 0.002 | 2.110 | 0.997 (0.994–1.001) | 0.146 |
| ACEI/ARB | 0.445 | 0.445 | 2.446 | 2.004 (0.838–4.79) | 0.118 |
| SU | 0.507 | 0.507 | 1.618 | 1.906 (0.705–5.149) | 0.203 |

*A family history of myocardial infarction, angina pectoris, or sudden death. AC, abdominal circumference; ACEI, angiotensin-converting-enzyme inhibitor; ARB, angiotensin II receptor blocker; BMI, body mass index; CI, confidence interval; MACE, major adverse cardiac events; OR, odds ratio; SFA, subcutaneous fat area; SU, sulfonylurea; VFA, visceral fat area.

**Results**

**Patient Characteristics**

The characteristics of all 529 patients (268 [51%] males, 261 [49%] females) are presented in Table 1. The frequency of HTN, DM, and DL in the entire patient cohort was 69%, 23%, and 62%, respectively. The mean age of patients was 66±11 years. There were significant differences in patient characteristics between the MACE and non-MACE groups. Specifically, the percentage of males, smokers, and those with CAD were significantly higher in the MACE than non-MACE group; in addition, the number of vessels with significant disease, the coronary artery calcium score, and the Gensini score were significantly higher in the MACE group (Table 1).

Table 2 shows the medications used by all patients, as well as those in the MACE and non-MACE groups separately. Among the entire patient cohort, 40%, 39%, and 36% of patients were using angiotensin-converting enzyme inhibitors (ACEI)/angiotensin II receptor blockers (ARB), calcium channel blockers, and statins, respectively. There were significant differences in medications used between the MACE and non-MACE groups, with the use of ARB/ACEI and sulfonylurea (SU) being significantly higher in the MACE group.

**BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA in the MACE and Non-MACE Groups**

Figure 1 shows BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA in the MACE and non-MACE groups. As can be seen from Figure 1, SFA and SFA/VFA were significantly lower in the MACE than non-MACE group.

**Predictors of MACE, Including BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA**

We used logistic regression analysis to investigate independent predictors of MACE in all patients (Table 3). We selected conventional coronary risk factors (age, sex, family history, smoking, HTN, DM, and DL), ACEI/ARB,
SU, BMI, AC, SFA, VFA, SFA/VFA, and SFA+VFA as variables. As indicated in Table 3, the presence of MACE was independently associated with BMI (P=0.042), AC (P=0.042), SFA (P=0.025), and SFA/VFA (P=0.008), but not with VFA or SFA+VFA.

**Correlation Between the Number of Metabolic Factors and SFA/VFA**

Subjects were divided into 5 groups according to the number (0–4) of metabolic factors (VFA ≥100 cm², fasting glucose ≥110 mg/dL, systolic blood pressure ≥135 mmHg and/or diastolic blood pressure ≥85 mmHg, and triglyceride ≥150 mg/dL and/or high-density lipoprotein-cholesterol <40 mg/dL. Data are the mean±SD. *P<0.05, **P<0.01. AU, arbitrary units.
The most important finding of the present study was that higher SFA/VFA is associated with a lower rate of MACE at the time of CCTA as screening for CAD. Higher SFA/VFA was more closely associated with a lower risk of MACE than higher BMI, AC, VFA, SFA, and SFA+VFA.

BMI is easy to determine and is the anthropometric measure most frequently used to investigate obesity. Conversely, the validity of BMI has been questioned. BMI does not reflect regional body fat distribution. In some studies, central obesity and abdominal fat were more closely associated with cardiometabolic risk factors and chronic disease risk than overall obesity. Therefore, using BMI could lead to an inaccurate assessment of fat. Although AC is a representative indicator of central obesity, the AUC values for both BMI and AC were relatively low in the present study. In addition, the results of a meta-analysis suggest a near J-shaped association between AC and all-cause mortality. Because SFA and VFA, which contribute to AC, are considered to be important indicators, SFA and/or VFA may be more important markers than AC.

The volume of SF that can accumulate is predetermined and varies according to the individual. When this limit is exceeded, adipocytes will accumulate as VFA. Adipocytes in visceral adipose tissue are enlarged and accumulate a large amount of neutral fat, but the amount that can be accumulated in VFA varies according to the individual. When fat storage in subcutaneous tissue is limited and energy intake becomes excessive, it becomes impossible to cope with the growth and enlargement of VFA, and the liver, pancreas, skeletal muscle, and cardiovascular system are affected. It is believed that ectopic fat deposition also progresses in organs. It has been reported that VF and SF differ in the differentiation of adipocytes themselves and exhibit distinctly different metabolic kinetics. For example, it has been reported that VF has higher lipogenic ability than SF. Thus, when patients have a higher SFA/VFA at the time of CCTA, their fat is mainly accumulated in SFA, rather than VFA. Patients with a higher SFA/VFA may have lower lipogenic ability, and the fat storage function in subcutaneous tissue may be maintained. VF and ectopic fat may accumulate further over time and atherosclerosis may progress. This may be one reason why patients with a higher SFA/VFA have a low prevalence of MACE.

In general, the periods in life during which SF increases dramatically are limited and are believed to be the neonatal period, infancy, adolescence, and pregnancy/childbirth in females. Premenopausal women, who have high levels of estrogen, have sufficient reserve capacity to accumulate SF, so that VF is unlikely to accumulate. Conversely, in adult males over 30 years of age and in postmenopausal females who are deficient in estrogen, the reserve capacity to accumulate SF is limited. When the energy intake exceeds consumption due to overeating and a lack of exercise, surplus energy is available and fat becomes VF. It may also enlarge and accumulate as ectopic fat. In the present study, the non-MACE and MACE groups were the same age, but the MACE group had a significantly higher percentage of males than the non-MACE group. Although plasma concentrations of estrogen, which is associated with SFA/VFA, were not measured in the present study, sex differences, such as in menopause and/or estrogen levels, may affect the presence of MACE.

**Discussion**

The most important finding of the present study was that higher SFA/VFA is associated with a lower rate of MACE at the time of CCTA as screening for CAD. Higher SFA/VFA was more closely associated with a lower risk of MACE than higher BMI, AC, VFA, SFA, and SFA+VFA.

BMI is easy to determine and is the anthropometric measure most frequently used to investigate obesity. Conversely, the validity of BMI has been questioned. BMI does not reflect regional body fat distribution. In some studies, central obesity and abdominal fat were more closely associated with cardiometabolic risk factors and chronic disease risk than overall obesity. Therefore, using BMI could lead to an inaccurate assessment of fat. Although AC is a representative indicator of central obesity, the AUC values for both BMI and AC were relatively low in the present study. In addition, the results of a meta-analysis suggest a near J-shaped association between AC and all-cause mortality. Because SFA and VFA, which contribute to AC, are considered to be important indicators, SFA and/or VFA may be more important markers than AC.

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**Study Limitations**

This study has several important limitations. First, the sample size was relatively small, which limited our ability to determine significance. Second, although MDCT is not a gold standard for the evaluation of CAD, recent studies have shown that both its sensitivity and specificity are approximately 95% of the sensitivity and specificity of invasive coronary angiography for the identification of significant coronary stenosis. Third, we did not take into account changes in body weight or fat area during the follow-up period. A large-scale prospective study will be needed to address these issues.

**Conclusions**

Our results suggest that SFA/VFA may be a useful marker for the presence of MACE.

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**IRM Information**

The deidentified participant data will not be shared.

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