MACHINE LEARNING COMPUTED TOMOGRAPHY RADIOMICS OF ABDOMINAL ADIPOSE TISSUE TO OPTIMIZE CARDIOVASCULAR RISK ASSESSMENT

SUPPLEMENTARY FILES

SUPPLEMENTARY TABLES

Supplementary Table S1: Radiomics quality score

	Score
Domain 1: Protocol quality and stability in image and segmentation (0 to 5 points)	**3**
Protocol quality (2)	2
Test-retest (1)	0
Phantom study (1)	0
Multiple segmentation (1)	1
Domain 2: Feature selection and validation (-8 to 8 points)	**6**
Feature selection or adjustment of multiple testing (-3 to 3)	3
Validation (-5, 2, 3, 4 or 5)	3
Domain 3: Biologic/clinical validation and utility (0 to 6 points)	**4**
Non-radiomic features (1)	1
Biologic correlates (1)	1
Comparison to “gold-standard” (2)	0
Potential clinical utility (2)	2
Domain 4: Model performance index (0 to 5 points)	**4**
Discrimination statistics (2)	2
Calibration statistics (2)	1
Cut-off analysis (1)	1
Domain 5: High level of evidence (0 to 8 points)	**7**
Prospective study (7)	7
Cost-effective analysis (1)	0
Domain 6: Open science and data (0 to 4 points)	**0**
Total	**24**

Supplementary Table S2: Abdominal fat radiomic features on non-contrast computed tomography

Feature group	Feature name
(1) First Order First-order statistics describe the distribution of voxel intensities within the image region defined by the mask through commonly used and basic metrics.	Percentile 10 Percentile 90 Energy Entropy Interquartile range Kurtosis Maximum Mean absolute deviation Mean Median Minimum Range Robust mean absolute deviation Root mean squared Skewness Total energy Uniformity Variance
(2) Shape	Elongation Flatness Maximum3D-diameter Mesh volume Minor axis length Sphericity Surface area Surface volume ratio Voxel volume
(3) GLRLM A Gray Level Run Length Matrix (GLRLM) quantifies gray level runs, which are defined as the length in number of pixels, of consecutive pixels that have the same gray level value.	Gray level non-uniformity Gray level non-uniformity normalized Gray level variance High gray level run emphasis Long run emphasis Long run high gray level emphasis Long run low gray level emphasis Low gray level run emphasis Run entropy Run length non uniformity Run length non uniformity mormalized Run percentage Run variance Short run emphasis

	Short run high gray level emphasis
	Short run low gray level emphasis
(4) GLSZM A Gray Level Size Zone Matrix (GLSZM) quantifies gray level zones in an image.	Gray level non-uniformity Gray level non-uniformity normalized Gray level variance High gray level zone emphasis Large area emphasis Large area high gray level emphasis Large area low gray level emphasis Low gray level zone emphasis Size zone non-uniformity Size zone non-uniformity normalized Small area emphasis Small area high gray level emphasis Small erea low gray level emphasis Zone entropy Zone percentage Zone variance
(5) GLCM A Gray Level Co-occurrence Matrix (GLCM) of size Ng×Ng Ng×Ng describes the second-order joint probability function of an image region constrained by the mask and is defined as P(i,j|δ,θ)P(i,j|δ,θ).	Autocorrelation Cluster prominence Cluster shade Cluster tendency Contrast Correlation Difference average Difference entropy Difference variance Inverse difference Inverse difference moment Inverse difference moment normalized Inverse difference normalized Information measure of correlation 1 Information measure of correlation 2 Inverse variance Joint average Joint energy Joint entropy Maximal correlation coefficient Maximum probability Sum average Sum Entropy Sum of Squares
(6) GLDM	Dependence entropy

A Gray Level Dependence Matrix (GLDM) quantifies gray level dependencies in an image.	Dependence non-uniformity Dependence non-uniformity normalized Dependence variance Gray level non-uniformity Gray level variance High gray level emphasis Large dependence emphasis Large dependence high gray level emphasis Large dependence low gray level emphasis Low gray level emphasis Small dependence emphasis Small dependence high gray level emphasis Small dependence low gray level emphasis
(7) NGTDM A Neighbouring Gray Tone Difference Matrix (NGTDM) quantifies the difference between a gray value and the average gray value of its neighbours within distance δδ.	Busyness Coarseness Complexity Contrast Strength

GLCM: gray level co-occurrence matrix; GLDM: gray level dependence matrix; GLRLM: gray level run-length matrix; GLSZM: gray level size zone matrix; NGTDM: neighbouring gray-tone difference matrix.

Supplementary Table S3: Number of abdominal fat radiomic features extracted per feature group

	Original	Wavelet LH-HL-HH-LL	Gradient	LBP-2D	Total
First order	18	72	18	18	108
Shape	14				14
GLRLM	16	64	16	16	96
GLSZM	16	64	16	16	96
GLCM	24	96	24	23	144
GLDM	14	56	14	14	84
NGTDM	5	20	5	5	30
	107	372	93	93	**665**

GLCM: gray level co-occurrence matrix; GLDM: gray level dependence matrix; GLRLM: gray level run-length matrix; GLSZM: gray level size zone matrix; HH: high-high; HL: high-low; LBP: local binary pattern; LH: low-high; LL: low-low; NGTDM: neighbouring gray-tone difference matrix.

Supplementary Table S4: Computed Tomography radiomic features of abdominal fat that discriminate SAF and VAF compartments

Radiomic Features	SAF	VAF	Median Difference (95% CI)	*P*-value
Wavelet_ll_gldm_large_dependence_high_gray_level_emphasis	1592976	439156	1153820 (932831; 1460799)	<0.001
Wavelet_ll_glszm_large_area_high_gray_level_emphasis	64,919	24,447	40472 (34464; 46971)	<0.001
Wavelet_ll_glrlm_long_run_high_gray_level_emphasis	25,892	12,904	12988 (11977; 13081)	<0.001
Wavelet_ll_glszm_high_gray_level_zone_emphasis	19,623	10,632	8991 (7322; 9304)	<0.001
Wavelet_ll_glrlm_high_gray_level_run_emphasis	19,274	10,499	8775 (7161; 9204)	<0.001
Wavelet_ll_gldm_high_gray_level_emphasis	19196	10453	8743 (7470; 8997)	<0.001
Wavelet_ll_glcm_autocorrelation	18,643	10,099	8544 (7470; 8997)	<0.001
Wavelet_ll_glrlm_short_run_high_gray_level_emphasis	17,965	10,030	7935 (6339; 8384)	<0.001
Wavelet_hh_gldm_gray_level_non_uniformity	3,388	1,469	1919 (1528; 2274)	<0.001
Wavelet_hh_glrlm_gray_level_non_uniformity	2,685	1,220	1465 (1128; 1713)	<0.001
Wavelet_hl_gldm_gray_level_non_uniformity	2,538	1,076	1462 (1119; 1836)	<0.001
Wavelet_ll_firstorder_minimum	-874	-691	-183 (-222; -145)	<0.001
Wavelet_ll_glcm_sum_average	273	201	72 (55; 88)	<0.001
LBP_2d_glszm_size_zone_non_uniformity	196	132	64 (53; 77)	<0.001
Wavelet_ll_gldm_large_dependence_emphasis	93	49	44 (34; 52)	<0.001
Wavelet_ll_glcm_joint_average	136	100	36 (28; 44)	<0.001
Wavelet_ll_glcm_joint_entropy	8.81	9.5	-0.69 (-0.72; -0.65)	<0.001
LBP_2d_glszm_zone_entropy	3.89	3.99	-0.1 (-0.11; -0.08)	<0.001
Wavelet_ll_glszm_small_area_emphasis	0.77	0.83	-0.06 (-0.06; 0.05)	<0.001

GLCM: gray level co-occurrence matrix; GLDM: gray level dependence matrix; GLRLM: gray level run-length matrix; GLSZM: the gray level size zone matrix; HH: High-High; HL: High-Low; LBP: local binary pattern; LH: Low-High; LL: Low-Low; SAF: subcutaneous abdominal fat; VAF: visceral abdominal fat