



Supplementary Figure 1. Feature variable selection based on the LASSO regression analysis.

(a) Plot of the LASSO coefficient profiles in dataset without VAT. (b) Tuning parameter selection cross-validation error curve in dataset without VAT.

(c) Plot of the LASSO coefficient profiles in dataset without TFM. (d) Tuning parameter selection cross-validation error curve in dataset without TFM.

VAT: Trunk Fat Mass, TFM: Visceral Adipose Tissue.

Supplementary Table 1. Baseline characteristic of controls before and after inverse probability weighting (IPW).

Variables	Before IPW				After IPW			
	Healthy controls (n=218)	Benign breast nodules (n=212)	<i>P</i> ^a	SMD ^b	Healthy controls (n=227.64)	Benign breast nodules (n=203.47)	<i>P</i>	SMD
Age, yr	65.50 (51.00, 72.00)	45.00 (35.00, 60.25)	<0.001	0.738	67.00 (58.00, 72.00)	52.00 (37.00, 67.00)	<0.001	0.639
Menopause, n (%)	164 (75.23)	88 (41.51)	<0.001	0.728	184.4 (81.00)	108.0 (53.08)	<0.001	0.622
BMI, kg/m ²	23.42 (20.95, 26.25)	23.34 (21.02, 26.73)	0.795	0.042	24.45 (21.56, 27.75)	24.09 (21.56, 27.07)	0.567	0.076
Overweight, n (%)	64 (29.36)	58 (27.36)	0.646	0.044	69.6 (30.57)	65.0 (31.95)	0.792	0.149
Obesity, n (%)	35 (16.06)	34 (16.04)	0.996	<0.001	55.8 (24.51)	37.5 (18.43)	0.248	0.030
Overweight or Obesity, n (%)	99 (45.41)	92 (43.40)	0.674	0.041	125.4 (55.09)	102.5 (50.38)	0.390	0.094
FP, %	32.35±7.88	31.99±6.84	0.624	0.047	33.85±8.25	32.84±6.82	0.213	0.134
FM, kg	19.80 (15.12, 25.00)	19.65 (14.57, 24.92)	0.690	0.044	21.32 (16.50, 26.71)	20.40 (15.83, 25.60)	0.355	0.128
FFM, kg	40.60 (37.20, 44.18)	41.30 (38.58, 44.82)	0.066	0.169	40.60 (37.56, 44.44)	41.40 (38.80, 44.90)	0.102	0.163
MM, kg	38.30 (34.92, 41.70)	38.80 (36.27, 42.32)	0.080	0.098	38.30 (35.29, 41.94)	39.00 (36.50, 42.40)	0.128	0.083
LMM, kg	16.20 (14.40, 18.08)	16.80 (15.40, 18.52)	0.014	0.191	16.20 (14.50, 18.10)	16.92 (15.40, 18.87)	0.019	0.212
TMM, kg	21.64 (20.02, 23.19)	19.50 (18.00, 21.83)	<0.001	0.609	21.80 (20.21, 23.21)	19.70 (18.10, 21.94)	<0.001	0.617
LFM, kg	8.90 (6.72, 11.20)	8.25 (6.27, 10.60)	0.106	0.151	9.50 (7.50, 11.91)	8.80 (6.72, 11.00)	0.061	0.249
TFM, kg	9.70 (7.50, 12.40)	10.40 (7.38, 13.03)	0.269	0.079	10.39 (8.00, 13.79)	10.80 (8.00, 13.68)	0.718	0.016
VAT, cm ²	97.50 (71.55, 132.75)	95.70 (64.07, 129.62)	0.452	0.088	106.59 (79.00, 144.00)	104.19 (74.81, 134.40)	0.257	0.178
marriage, n (%)			0.015	0.317			0.151	0.242
Married	151 (69.27)	155 (73.11)			166.2 (73.01)	148.2 (72.84)		
Single	22 (10.10)	33 (15.57)			18.2 (8.00)	25.9 (12.73)		
Divorced	8 (3.67)	8 (3.77)			7.2 (3.16)	9.6 (4.72)		
Widowed	37 (16.97)	16 (7.55)			36.0 (15.81)	19.6 (9.63)		
smoking, n (%)	13 (5.96)	13 (6.13)	0.942	0.007	11.6 (5.10)	10.2 (5.01)	0.961	0.004
drinking, n (%)	24 (11.01)	20 (9.43)	0.590	0.052	19.7 (8.65)	15.1 (7.42)	0.617	0.045
exercise, n (%)	130 (59.63)	137 (64.62)	0.286	0.103	139.0 (61.06)	138.3 (67.97)	0.193	0.144
Diabetes, n (%)	52 (23.85)	26 (12.26)	0.002	0.305	48.1 (21.13)	24.8 (12.19)	0.027	0.242
Hypertension, n (%)	71 (32.57)	58 (27.36)	0.239	0.114	75.0 (32.95)	71.4 (35.09)	0.694	0.046

Supplementary Table 1. Baseline characteristic of controls before and after inverse probability weighting (IPW) (continued).

Variables	Before IPW				After IPW			
	Healthy controls (n=218)	Benign breast nodules (n=212)	<i>P</i>	SMD	Healthy controls (n=227.64)	Benign breast nodules (n=203.47)	<i>P</i>	SMD
Hyperlipidemia, n (%)	64 (29.36)	35 (16.51)	0.002	0.309	59.7 (26.23)	31.1 (15.28)	0.009	0.272
Coronary heart disease, n (%)	32 (14.68)	19 (8.96)	0.067	0.178	29.1 (12.78)	24.8 (12.19)	0.870	0.018
Liver dysfunction, n (%)	8 (3.67)	7 (3.30)	0.835	0.020	15.7 (6.90)	15.9 (7.81)	0.831	0.034
Renal dysfunction, n (%)	10 (4.59)	5 (2.36)	0.208	0.122	16.6 (7.29)	7.8 (3.83)	0.258	0.151
HOMA-IR	2.06 (1.23, 3.29)	2.04 (1.21, 3.16)	0.748	0.021	2.29 (1.38, 4.33)	2.29 (1.36, 4.02)	0.699	0.062
TC, mmol/L	4.72 (4.13, 5.56)	4.76 (4.20, 5.31)	0.688	0.079	4.79 (4.16, 5.67)	4.86 (4.20, 5.42)	0.712	0.083
TG, mmol/L	1.15 (0.81, 1.62)	1.03 (0.68, 1.61)	0.112	0.011	1.25 (0.86, 1.77)	1.19 (0.73, 1.74)	0.382	0.026
HDL, mmol/L	1.35 (1.11, 1.63)	1.37 (1.17, 1.65)	0.720	0.042	1.32 (1.09, 1.56)	1.34 (1.16, 1.59)	0.641	0.017
LDL, mmol/L	2.77 (2.26, 3.33)	2.72 (2.35, 3.24)	0.951	0.041	2.84 (2.27, 3.44)	2.89 (2.44, 3.31)	0.944	0.058
FFA, mmol/L	622.50 (459.00, 877.62)	660.60 (474.78, 822.02)	0.837	0.001	615.91 (425.54, 878.41)	692.40 (471.52, 841.39)	0.409	0.062

^a Mann-Whitney test and independent-samples t test were used for continuous variables and chi-square test and Fisher's exact test were used for categorical variables.

^b SMD: Standardized mean difference, BMI: Body mass index, FP: Fat percentage, FM: Fat mass, FFM: Fat-free mass, MM: Muscle mass, LMM: Limb muscle mass, TMM: Trunk muscle mass, LFM: Limb fat mass, TFM: Trunk fat mass, VAT: Visceral adipose tissue, HOMA-IR: Homeostatic model assessment of insulin resistance, TC: Total cholesterol, TG: Triglyceride, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, FFA: Free fatty acid.

p-values less than 0.05 and SMDs larger than 0.2 are shown in bold.

Supplementary Table 2. Baseline characteristic of patients with breast cancer after radical mastectomy.

Variables	Total (n=187)	Pre-menopause (n=27)	Post-menopause (n=160)	P ^a
Age, yr	66.00 (59.00, 71.00)	45.59±9.51	67.04±7.45	<0.001
Menopause, n (%)	160 (85.56)	0 (0.00)	160 (100.00)	<0.001
BMI ^b , kg/m ²	24.89 (22.88, 27.70)	23.07 (22.47, 27.25)	25.05 (23.06, 27.74)	0.181
Overweight, n (%)	75 (40.11)	8 (29.63)	67 (41.88)	0.230
Obesity, n (%)	42 (22.46)	5 (18.52)	37 (23.13)	0.596
Overweight or Obesity, n (%)	117 (62.57)	13 (48.15)	104 (65.00)	0.094
FP, %	36.06±6.48	34.49±7.57	36.33±6.27	0.173
FM, kg	23.10 (18.95, 27.80)	21.90 (17.80, 27.80)	23.20 (19.53, 27.75)	0.296
FFM, kg	41.40 (38.75, 44.25)	42.10 (39.70, 43.90)	41.05 (38.50, 44.30)	0.255
MM, kg	38.80 (36.60, 41.60)	39.70 (37.70, 41.45)	38.70 (36.38, 41.60)	0.147
LMM, kg	16.60 (15.20, 18.15)	17.40 (16.10, 18.20)	16.40 (15.17, 18.02)	0.046
TMM, kg	20.50 (18.70, 22.20)	20.80 (19.25, 21.40)	20.30 (18.30, 22.60)	0.606
LFM, kg	9.80 (8.15, 11.85)	9.60 (7.55, 11.45)	9.90 (8.20, 11.93)	0.324
TFM, kg	12.20 (9.75, 14.85)	11.20 (9.10, 15.05)	12.40 (10.30, 14.75)	0.235
VAT, cm ²	128.60 (96.55, 149.85)	118.00 (77.45, 141.60)	130.00 (99.75, 150.25)	0.068
marriage, n (%)				0.500
Married	134 (71.66)	21 (77.78)	113 (70.63)	
Single	15 (8.02)	2 (7.41)	13 (8.13)	
Divorced	8 (4.28)	2 (7.41)	6 (3.75)	
Widowed	30 (16.04)	2 (7.41)	28 (17.50)	
smoking, n (%)	13 (6.95)	3 (11.11)	10 (6.25)	0.610
drinking, n (%)	9 (4.81)	1 (3.70)	8 (5.00)	1.000
exercise, n (%)	132 (70.59)	15 (55.56)	117 (73.13)	0.104
Diabetes, n (%)	44 (23.53)	8 (29.63)	36 (22.50)	0.574
Hypertension, n (%)	113 (60.43)	14 (51.85)	99 (61.88)	0.440
Hyperlipidemia, n (%)	35 (18.72)	4 (14.81)	31 (19.38)	0.768
Coronary heart disease, n (%)	28 (14.97)	1 (3.70)	27 (16.88)	0.138
Liver dysfunction, n (%)	64 (34.22)	10 (37.04)	54 (33.75)	0.910
Renal dysfunction, n (%)	52 (27.81)	7 (25.93)	45 (28.13)	0.997
HOMA-IR	3.08 (1.74, 6.52)	2.03 (1.33, 4.77)	3.29 (1.87, 6.87)	0.082
TC, mmol/L	4.90 (4.10, 5.67)	4.40 (3.88, 4.93)	5.00 (4.10, 5.77)	0.006
TG, mmol/L	1.38 (1.02, 1.86)	1.24 (0.75, 1.77)	1.43 (1.02, 1.86)	0.121
HDL, mmol/L	1.26 (1.00, 1.45)	1.37 (1.20, 1.49)	1.22 (0.99, 1.45)	0.117
LDL, mmol/L	3.05 (2.41, 3.59)	2.62 (2.27, 3.01)	3.17 (2.47, 3.70)	0.005
FFA, mmol/L	709.60 (491.05, 902.65)	811.00 (608.85, 960.40)	701.55 (475.05, 885.60)	0.112
CEA, ng/ml	2.07 (1.39, 3.28)	1.56 (0.84, 2.08)	2.13 (1.42, 3.46)	0.011
CA 199, u/ml	11.90 (7.43, 21.80)	12.40 (5.74, 22.47)	11.75 (7.79, 21.30)	0.649
CA 724, u/ml	1.59 (1.45, 3.56)	2.21 (1.33, 5.89)	1.56 (1.48, 3.34)	0.522
CA 153, u/ml	11.00 (7.41, 16.30)	11.70 (6.78, 15.85)	11.00 (7.43, 16.44)	0.892

Supplementary Table 2. Baseline characteristic of patients with breast cancer after radical mastectomy (continued).

Variables	Total (n=187)	Pre-menopause (n=27)	Post-menopause (n=160)	P
Albumin, g/L	44.60 (42.45, 46.85)	46.00 (42.80, 49.00)	44.45 (42.32, 46.42)	0.116
Lymphocyte, 10⁹/L	1.51 (1.21, 1.89)	1.40 (1.14, 1.98)	1.51 (1.21, 1.88)	0.424
Neutrophils, 10⁹/L	3.79 (3.10, 4.59)	3.77 (3.17, 4.93)	3.79 (3.10, 4.46)	0.368
TNM, n (%)				0.636
0	2 (1.07)	0 (0.00)	2 (1.25)	
I	48 (25.67)	9 (33.33)	39 (24.38)	
II	109 (58.29)	14 (51.85)	95 (59.38)	
III	22 (11.76)	4 (14.81)	18 (11.25)	
IV	6 (3.21)	0 (0.00)	6 (3.75)	
Pathology, n (%)				0.701
Carcinoma in situ	14 (7.49)	2 (7.41)	12 (7.50)	
Infiltrating carcinoma	165 (88.24)	25 (92.59)	140 (87.50)	
Sarcoma & metaplastic carcinoma & Phyllodes tumor	2 (1.07)	0 (0.00)	2 (1.25)	
Others	6 (3.21)	0 (0.00)	6 (3.75)	
Histological grade, n (%)				0.269
0	54 (28.88)	12 (44.44)	42 (26.25)	
I	8 (4.28)	1 (3.70)	7 (4.38)	
II	79 (42.25)	8 (29.63)	71 (44.38)	
III	46 (24.60)	6 (22.22)	40 (25.00)	
Tumor long diameter, mm	23.00 (16.00, 33.00)	25.00 (16.00, 40.00)	23.00 (16.00, 32.00)	0.419
ER, n (%)				0.660
Positive	128 (68.45)	17 (62.96)	111 (69.38)	
Negative	59 (31.55)	10 (37.04)	49 (30.63)	
PR, n (%)				1.000
Positive	123 (65.78)	18 (66.67)	105 (65.63)	
Negative	64 (34.22)	9 (33.33)	55 (34.38)	
HER², n (%)				0.050
3 ⁺	37 (19.79)	10 (37.04)	27 (16.88)	
2 ⁺	68 (36.36)	7 (25.93)	61 (38.13)	
1 ⁺	24 (12.83)	1 (3.70)	23 (14.38)	
Negative	58 (31.02)	9 (33.33)	49 (30.63)	
Ki-67, n (%)				1.000
Positive	185 (98.93)	27 (100.00)	158 (98.75)	
Negative	2 (1.07)	0 (0.00)	2 (1.25)	
Lymph node infiltration, n (%)	78 (41.71)	12 (44.44)	66 (41.25)	0.920
Pre-surgery therapy, n (%)	46 (24.60)	9 (33.33)	37 (23.13)	0.369
Post-surgery therapy, n (%)	123 (65.78)	19 (70.37)	104 (65.00)	0.745
Distant metastasis, n (%)	10 (5.35)	2 (7.41)	8 (5.00)	0.607

Supplementary Table 2. Baseline characteristic of patients with breast cancer after radical mastectomy (continued).

Variables	Total (n=187)	Pre-menopause (n=27)	Post-menopause (n=160)	P
Distant metastasis-free survival time, months	17.00 (10.00, 33.00)	23.00 (11.00, 44.50)	17.00 (9.00, 29.00)	0.197

^a Mann-Whitney test and independent-samples t test were used for continuous variables and Fisher's exact test was used for categorical variables. p-values less than 0.05 were shown in bold

^b BMI: Body mass index, FP: Fat percentage, FM: Fat mass, FFM: Fat-free mass, MM: Muscle mass, LMM: Limb muscle mass, TMM: Trunk muscle mass, LFM: Limb fat mass, TFM: Trunk fat mass, VAT: Visceral adipose tissue, HOMA: Homeostatic model assessment of insulin resistance, TC: Total cholesterol, TG: Triglyceride, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, FFA: Free fatty acid, CEA: Carcinoembryonic antigen, CA: Carbohydrate antigen, ER: Estrogen receptor, PR: Progesterone receptor

Supplementary Table 3. The association of body composition and distant metastasis in patients with breast cancer post-radical mastectomy^a.

Variables	Overall		Post-menopause		Follow up ≥2yr	
	HR (95%CI)	P	HR (95%CI)	P	HR (95%CI)	P
FP, % ^b	0.922 (0.837, 1.016)	0.100	0.919 (0.821, 1.029)	0.145	0.780 (0.622, 0.978)	0.032
FM, kg	0.914 (0.823, 1.015)	0.093	0.923 (0.821, 1.039)	0.184	0.762 (0.598, 0.971)	0.028
FFM, kg	0.934 (0.814, 1.070)	0.325	0.953 (0.817, 1.112)	0.542	0.883 (0.725, 1.075)	0.214
MM, kg	0.919 (0.791, 1.068)	0.272	0.946 (0.804, 1.114)	0.505	0.861 (0.694, 1.068)	0.172
LMM, kg	0.750 (0.590, 0.953)	0.019	0.763 (0.579, 1.006)	0.055	0.713 (0.500, 1.019)	0.063
TMM, kg	0.917 (0.732, 1.150)	0.455	0.925 (0.720, 1.189)	0.543	0.821 (0.574, 1.173)	0.278
LFM, kg	0.932 (0.785, 1.011)	0.417	0.969 (0.817, 1.149)	0.720	0.481 (0.263, 0.880)	0.018
TFM, kg	0.856 (0.712, 1.030)	0.100	0.870 (0.705, 1.075)	0.197	0.639 (0.422, 0.967)	0.034
VAT, cm ²	0.956 (0.969, 1.002)	0.094	0.987 (0.969, 1.006)	0.189	0.959 (0.923, 0.998)	0.037

^a Univariable COX regression was used for analysis. p-values less than 0.05 were shown in bold

^b FP: Fat percentage, FM: Fat mass, FFM: Fat-free mass, MM: Muscle mass, LMM: Limb muscle mass, TMM: Trunk muscle mass, LFM: Limb fat mass, TFM: Trunk fat mass, VAT: Visceral adipose tissue.