Supplementary Data to the Manuscript

Normalized Indices Derived from Visceral Adipose Mass Assessed by Magnetic Resonance Imaging and Their Correlation with Markers for Insulin Resistance and Prediabetes

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Table S1

a) Anthropometric and metabolic data for the TDFS cohort including significance levels between females and males as well as difference of mean (Diff of Mean) and upper/lower 95% confidence intervals (CI)

	all		females		males		
	1295		801		494		
	mean±SD	range	mean±SD	range	mean±SD	range	p
age [years]	44.8±13.3	18-77	44.1±12.7	18-77	45.9±14.2	18-75	0.029
	Diff of Mean:	*1.8*	*Upper CI:*	*3.17*	*Lower CI:*	*0.17*	
height [cm]	170.7±8.9	148-198	165.9±6.3	148-185	178.6±6.6	159-198	< 0.0001
	Diff of Mean:	*12.7*	*Upper CI:*	*13.41*	*Lower CI:*	*11.96*	

BMI [kg/m²]	29.9±5.9	17.7-55.1	29.8±6.2	17.7-55.1	30.1±5.4	18.6-50.8	0.338
	Diff of Mean:	*0.3*	*Upper CI:*	*0.99*	*Lower CI:*	*-0.43*	
WHR	0.89±0.09	0.61-1.18	0.85±0.07	0.61-1.15	0.97±0.07	0.70-1.18	< 0.0001
	Diff of Mean:	*0.12*	*Upper CI:*	*0.133*	*Lower CI:*	*0.118*	
ISI Mats [a.u.]	9.8±6.1	0.9-38.1	10.2±6.1	1.2-38.1	9.2±6.0	0.9-32.9	0.0028
	Diff of Mean:	*-1.05*	*Upper CI:*	*-0.36*	*Lower CI:*	*-1.74*	
HbA1c [mmol/mol]	37.7±4.5	21.3-54.1	37.7±4.3	25.7-54.1	37.6±4.8	21.3-54.1	0.740
	Diff of Mean:	*0.07*	*Upper CI:*	*0.44*	*Lower CI:*	*-0.61*	

b) Anthropometric and metabolic data in UKBB study cohort including significance levels between females and males as well as difference of mean (Diff of Mean) and upper/lower 95% confidence intervals (CI)

	all		females		males		
	1295		801		494		
	mean±SD	range	mean±SD	range	mean±SD	range	p
age [years]	55.4 ± 7.5	40-70	54.7 ± 7.4	40-70	56.2 ± 7.6	40-70	<0.00001
	Diff of Mean:	*-1.46*	*Upper CI:*	*-1.75*	*Lower CI:*	*-1.17*	
height [cm]	169.1 ± 9.2	141-201	162.8 ± 6.2	141-195	176.0 ± 6.6	152-198	<0.00001
	Diff of Mean:	*-13.25*	*Upper CI:*	*-13.50*	*Lower CI:*	*-13.00*	
BMI [kg/m²]	26.7 ± 4.4	14.2-55.2	26.2 ± 4.7	14.2-55.2	27.1 ± 3.9	16.4-48.4	<0.00001
	Diff of Mean:	*-0.87*	*Upper CI:*	*-1.04*	*Lower CI:*	*-0.70*	
WHR	0.86 ± 0.08	0.62-1.20	0.81 ± 0.07	0.62-1.11	0.92 ± 0.06	0.73-1.15	<0.00001
	Diff of Mean:	*-0.11*	*Upper CI:*	*-0.113*	*Lower CI:*	*-0.108*	
HbA1c [mmol/mol]	35.1 ± 5.0	16.1-93.6	34.9 ± 4.7	21.8-91.1	35.3 ± 5.4	16.1-93.6	0.0002
	Diff of Mean:	*-0.40*	*Upper CI:*	*-0.04*	*Lower CI:*	*-0.01*	

Table S2

a) MR-derived parameters for the TDFS cohort including significance levels between females and males with difference of mean and upper/lower 95% confidence intervals (CI)

	all		females		males		
	mean±SD	range	mean±SD	range	mean±SD	range	p
TAT [l]	36.0±14.4	7.8-103.8	37.8±14.6	10.1-96.3	33.3±13.7	7.8-103.8	< 0.0001
	Diff of Mean:	*-4.5*	*Upper CI:*	*-2.90*	*Lower CI:*	*-6.13*	
TLT [l]	48.2±10.0	29.5-84.5	42.3±5.9	29.5-68.7	57.6±7.7	39.2-84.5	< 0.0001
	Diff of Mean:	*15.3*	*Upper CI:*	*16.08*	*Lower CI:*	*14.57*	
VAT [l]	3.8±2.4	0.3-13.9	2.9±1.7	0.3-10.9	5.5±2.6	0.4-13.9	< 0.0001
	Diff of Mean:	*2.60*	*Upper CI:*	*2.83*	*Lower CI:*	*2.37*	
VAT/m [l/m]	2.24±1.37	0.14-8.09	1.72±1.03	0.14-6.59	3.06±1.44	0.25-8.09	< 0.0001
	Diff of Mean:	*1.34*	*Upper CI:*	*1.47*	*Lower CI:*	*1.20*	
VAT/m² [l/m²]	1.30±0.78	0.08-4.74	1.04±0.63	0.08-4.07	1.72±0.81	0.14-4.74	< 0.0001
	Diff of Mean:	*0.68*	*Upper CI:*	*0.75*	*Lower CI:*	*0.60*	
VAT/m³ [l/m³]	0.76±0.45	0.05-2.78	0.63±0.39	0.05-2.56	0.97±0.46	0.08-2.78	< 0.0001
	Diff of Mean:	*0.34*	*Upper CI:*	*0.38*	*Lower CI:*	*0.29*	
%VAT	10.9±6.0	1.5-30.3	7.4±3.1	1.5-22.2	16.5±5.2	2.4-30.3	< 0.0001
	Diff of Mean:	*9.1*	*Upper CI:*	*9.6*	*Lower CI:*	*8.7*	
VAT/TLT	7.7±4.0	0.6-22.3	6.6±3.6	0.6-20.7	9.4±4.0	0.8-22.3	< 0.0001
	Diff of Mean:	*2.8*	*Upper CI:*	*3.2*	*Lower CI:*	*2.3*	
VAT/WEI	4.2±2.1	0.4-13.0	3.3±1.6	0.4-9.7	5.5±2.1	0.5-13.0	< 0.0001
	Diff of Mean:	*2.2*	*Upper CI:*	*2.4*	*Upper CI:*	*2.0*	

b) MR-derived parameters in UKBB study cohort including significance levels between females and males

	all		females		males		
	mean±SD	range	mean±SD	range	mean±SD	range	
TrunkAT [l]	10.7±4.5	0.93-32.6	10.7±4.7	0.9-32.6	10.8±4.5	1.0-32.6	0.529
	Diff of Mean:	-0.22	*Upper CI:*	-0.45	*Upper CI:*	0.009	

TMVol[#] [l]	10.3±2.6	3.8-21.4	8.4±1.2	3.8-14.8	12.5±1.8	5.2-21.4	p < 0.0001
	Diff of Mean:	-4.17	*Upper CI:*	-4.23	*Upper CI:*	-4.11	
VAT [l]	3.7±2.2	0.1-14.4	2.6±1.5	0.1-12.1	4.9±2.3	0.3-14.4	p < 0.0001
	Diff of Mean:	-2.25	*Upper CI:*	-2.33	*Upper CI:*	-2.18	
VAT/m [l/m]	2.18 ±1.27	0.07-8.72	1.62±0.93	0.07-7.5	2.77 ±1.31	0.14-8.72	p < 0.0001
	Diff of Mean:	-1.16	*Upper CI:*	-1.20	*Upper CI:*	-1.11	
VAT/m² [l/m²]	1.28±0.72	0.05-5.49	1.00±0.58	0.05-4.61	1.58±0.75	0.08-5.49	p < 0.0001
	Diff of Mean:	-0.58	*Upper CI:*	-0.61	*Upper CI:*	-0.55	
VAT/m³ [l/m³]	0.75±0.42	0.03-3.45	0.61±0.36	0.03-2.84	0.90±0.43	0.05-3.45	p < 0.0001
	Diff of Mean:	-0.28	*Upper CI:*	-0.30	*Upper CI:*	-0.27	
%VAT*	33.6±12.7	6.2-70.5	23.8±6.5	6.2-53.4	44.3±8.4	17.3-70.5	p < 0.0001
	Diff of Mean:	-20.53	*Upper CI:*	-20.82	*Upper CI:*	-20.23	
VAT/TLT**	35.0±17.9	1.4-139.0	31.5±17.0	1.4-128.8	38.9±18.0	2.0-139.0	p < 0.0001
	Diff of Mean:	-7.39	*Upper CI:*	-8.09	*Upper CI:*	-6.70	
VAT/WEI	4.6±2.2	0.3-14.5	3.7±1.7	0.2-11.7	5.7±2.2	0.4-14.5	p < 0.0001
	Diff of Mean:	-2.00	*Upper CI:*	-2.07	*Upper CI:*	-1.92	

[#] = *Thigh Muscle Volume, * = VAT/TrunkAT, ** = VAT/Thigh Muscle Volume*

Table S3

a) Insulin sensitive (IS) vs. insulin resistant (IR) subjects in different age groups (AG) for the TDFS cohort

	females			males		
	AG1	AG2	AG3	AG1	AG2	AG3
age	19-37	38-51	52-77	18-39	40-54	55-75
n (IS/IR)	209/60	227/49	171/85	136/27	118/47	116/49
VAT [l] IS	1.66±0.96	2.44±1.28	3.34±1.62	3.48±2.06	5.21±1.96	5.94±2.07
VAT [l] IR	3.28±1.45	4.40±1.64	4.68±1.71	6.15±1.98	7.84±2.21	7.89±2.27
VAT/m [l/m] IS	0.99±0.57	1.46±0.76	2.03±0.99	1.91±1.12	2.91±1.07	3.36±1.17
VAT/m [l/m] IR	1.97±0.89	2.65±0.95	2.89±1.04	3.42±1.08	4.38±1.19	4.52±1.25
VAT/m² [l/m²] IS	0.59±0.34	0.88±0.45	1.24±0.61	1.05±0.61	1.63±0.59	1.90±0.66
VAT/m² [l/m²] IR	1.19±0.54	1.60±0.56	1.79±0.64	1.90±0.60	2.45±0.66	2.59±0.70
VAT/m³ [l/m³] IS	0.35±0.20	0.53±0.27	0.76±0.37	0.58±0.33	0.91±0.33	1.08±.0.38
VAT/m³ [l/m³] IR	0.71±0.33	0.97±0.34	1.11±0.40	1.06±0.34	1.37±0.37	1.49±0.40
%VAT IS	5.32±2.08	6.48±2.12	9.07±3.35	11.86±3.87	17.41±3.98	19.51±4.21
%VAT IR	7.00±2.40	8.82±2.21	10.66±2.64	13.89±4.37	17.55±3.82	20.64±4.01
VAT/TLT IS	3.96±1.91	5.55±2.56	8.06±3.56	6.06±3.18	8.87±2.96	10.70±3.35
VAT/TLT IR	7.33±2.98	9.16±2.90	10.96±3.39	9.43±2.66	12.52±2.93	13.68±3.34
VAT/WEI IS	2.12±0.90	2.88±1.16	4.07±1.63	3.67±1.69	5.45±1.56	6.40±1.76
VAT/WEI IR	3.49±1.28	4.44±1.22	5.30±1.40	5.37±1.49	6.97±1.41	7.76±1.73

b) healthy (H) vs. prediabetic (PRED) subjects in different age groups for the TDFS cohort

	females			males		
	AG1	AG2	AG3	AG1	AG2	AG3
age	19-37	38-51	52-77	18-39	40-54	55-75
n (H/PRED)	206/104	111/171	40/169	120/44	52/97	40/141
VAT [l] H	1.83±1.09	2.41±1.30	2.79±1.28	3.51±2.17	5.39±2.52	5.94±1.49
VAT [l] PRED	2.53±1.50	3.32±1.75	4.02±1.74	4.96±2.28	6.26±2.32	6.54±2.40
VAT/m [l/m] H	1.10±0.65	1.44±0.78	1.68±0.77	1.93±1.18	3.01±1.39	3.36±0.86
VAT/m [l/m] PRED	1.51±0.91	2.01±1.05	2.47±1.06	2.75±1.25	3.51±1.27	3.72±1.36

VAT/m² [l/m²] H	0.66±0.39	0.86±0.47	1.01±0.47	1.06±0.64	1.68±0.77	1.90±0.50
VAT/m² [l/m²] PRED	0.91±0.55	1.21±0.63	1.52±0.65	1.53±0.69	1.96±0.70	2.11±0.77
VAT/m³ [l/m³] H	0.39±0.24	0.52±0.29	0.61±0.28	0.58±0.35	0.94±0.43	1.08±0.30
VAT/m³ [l/m³] PRED	0.55±0.34	0.73±0.39	0.93±0.41	0.86±0.39	1.10±0.39	1.20±0.45
%VAT H	5.37±2.03	6.37±2.19	8.07±2.71	11.76±3.94	17.33±4.23	19.56±4.49
%VAT PRED	6.51±2.35	7.73±2.53	10.24±3.21	13.15±4.29	17.32±3.82	19.76±4.08
VAT/TLT H	4.30±2.13	5.44±2.67	6.61±2.78	6.04±3.22	8.94±3.36	13.98±2.92
VAT/TLT PRED	5.74±3.01	7.38±3.41	9.66±3.58	8.08±3.31	10.37±3.39	11.56±3.71
VAT/WEI H	2.25±0.96	2.81±1.21	3.47±1.36	3.66±1.73	5.45±1.72	6.42±1.59
VAT/WEI PRED	2.90±1.31	3.67±1.46	4.80±1.59	4.67±1.75	6.06±1.64	6.79±1.90

c) healthy (H) vs. prediabetic (PRED) subjects in different age groups in the UKBB study cohort

	females			males		
	AG1	AG2	AG3	AG1	AG2	AG3
age	40-51	52-59	60-70	40-52	53-60	63-70
n (H/PRED)	1653/112	1610/233	1267/311	1373/133	1402/270	1297/317
VAT [l] H	2.36±1.41	2.61±1.49	2.68±1.45	4.56±2.26	4.83±2.30	4.79±2.20
VAT [l] PRED	3.31±1.78	3.21±1.80	3.36±1.53	5.33±2.36	5.87±2.49	5.96±2.36
VAT/m [l/m] H	1.44±0.86	1.61±0.92	1.66±0.90	2.56±1.26	2.74±1.30	2.74±1.25
VAT/m [l/m] PRED	2.05±1.10	1.99±1.10	2.10±0.95	3.01±1.32	3.34±1.41	3.42±1.37
VAT/m² [l/m²] H	0.89±0.53	0.99±0.57	1.03±0.56	1.45±0.71	1.56±0.74	1.57±0.71
VAT/m² [l/m²] PRED	1.25±0.68	1.23±0.68	1.31±0.59	1.70±0.75	1.91±0.80	1.96±0.80
VAT/m³ [l/m³] H	0.54±0.33	0.61±0.36	0.64±0.35	0.82±0.40	0.89±0.42	0.90±.0.41
VAT/m³ [l/m³] PRED	0.77±0.43	0.76±0.42	0.81±0.37	0.97±0.42	1.09±0.47	1.13±0.47
%VAT H	21.8±5.9	23.7±6.2	25.2±6.7	42.3±8.1	44.4±8.2	45.1±8.4
%VAT PRED	24.0±6.3	25.2±6.6	27.3±6.8	43.2±9.0	46.6±7.9	47.6±8.5
VAT/TLT H	26.9±15.2	31.4±16.7	33.5±17.1	34.1±16.5	38.2±17.3	40.0±17.8
VAT/TLT PRED	36.1±18.2	37.6±19.4	41.5±17.8	40.3±17.5	46.7±19.1	49.8±19.8
VAT/WEI H	3.23±1.53	3.67±1.64	3.90±1.68	5.17±2.08	5.64±2.12	5.76±2.14
VAT/WEI PRED	4.10±1.78	4.22±1.80	4.66±1.70	5.88±2.14	6.54±2.14	6.83±2.23

Table S4

VAT-related indices for categorized variables of insulin sensitive (IS) and insulin resistant (IR) as well as healthy (H) and prediabetic (PRED) females and males

Females	n		VAT [l]	VAT/m [l/m]	VAT/m² [l/m²]	VAT/m³ [l/m³]	%VAT	VAT/TLT	VAT/WEI
TDFS									
	607	IS	2.44	1.47	0.89	**.053**	6.82	5.72	2.96
	194	IR	4.18	2.55	1.56	**0.95**	9.02	9.39	4.51
p			<0.0001	<0.0001	<0.0001	**<0.0001**	<0.0001	<0.0001	<0.0001
Diff of Mean			1.74	1.08	0.67	**0.42**	2.19	3.67	1.54
upper CI			2.00	1.24	0.77	**0.48**	2.69	4.21	1.80
lower CI			1.49	0.93	0.58	**0.36**	1.70	3.13	1.30
	357	H	2.12	1.27	0.76	0.46	5.97	4.90	2.55
	444	PRED	3.40	2.07	1.26	0.77	8.40	7.85	3.91
p			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diff of Mean			1.28	0.80	0.50	0.31	2.42	2.95	1.36
upper CI			1.50	0.93	0.58	0.36	2.82	3.41	1.57
lower CI			1.06	0.67	0.42	0.26	2.03	2.50	1.16
UKBB									
	4176	H	2.54	1.56	0.96	0.59	23.43	30.37	3.57
	598	PRED	3.34	2.07	1.28	0.80	26.23	39.60	4.45
p			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diff of Mean			-0.75	-0.48	-0.30	-0.19	-2.60	-8.72	-0.83
upper CI			-0.87	-0.55	-0.35	-0.22	-3.13	-10.10	-0.96
lower CI			-0.63	-0.40	-0.26	-0.16	-2.07	-7.33	-0.69

Males	n		VAT [l]	VAT/m [l/m]	VAT/m² [l/m²]	VAT/m³ [l/m³]	%VAT	VAT/TLT	VAT/WEI
TDFS									
	370	IS	4.69	2.62	1.47	0.82	15.89	8.24	5.01
	124	IR	7.37	4.15	2.34	1.32	17.94	12.11	6.86
p			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diff of Mean			2.68	1.53	0.87	0.50	2.05	3.87	1.85
upper CI			3.13	1.78	1.01	0.58	3.06	4.59	2.24
lower CI			2.23	1.28	0.73	0.42	1.04	3.15	1.47
	212	H	4.41	2.45	1.36	0.76	14.52	7.58	4.59
	282	PRED	6.21	3.50	1.97	1.12	17.92	10.63	6.22
p			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diff of Mean			1.80	1.05	0.61	0.36	3.40	3.05	1.63
upper CI			2.24	1.29	0.75	0.43	4.28	3.72	1.99
lower CI			1.37	0.81	0.48	0.28	2.53	2.38	1.28
UKBB									
	4071	H	4.72	2.68	1.52	0.87	43.89	37.41	5.52
	720	PRED	5.83	3.33	1.90	1.09	46.51	47.03	6.56
p			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diff of Mean			-1.11	-0.65	-0.38	-0.22	-2.62	-9.62	-1.04
upper CI			-1.29	-0.75	-0.44	-0.26	-3.28	-11.04	-1.21
lower CI			-0.93	-0.55	-0.32	-0.19	-1.96	-8.19	-0.87

Data are presented as Mean with Difference of Mean (Diff of Mean) and upper/lower 95%-confidence intervals (CI). Where VAT/m = VAT/body height, VAT/m² = VAT/body height², VAT/m³ = VAT/body height³. The UKBB MRI protocol does not include measurement of total adipose or lean tissue, therefore within this dataset %VAT = VAT/total abdominal adipose tissue, VAT/TLT = VAT/thigh muscle volume.

Figure S1

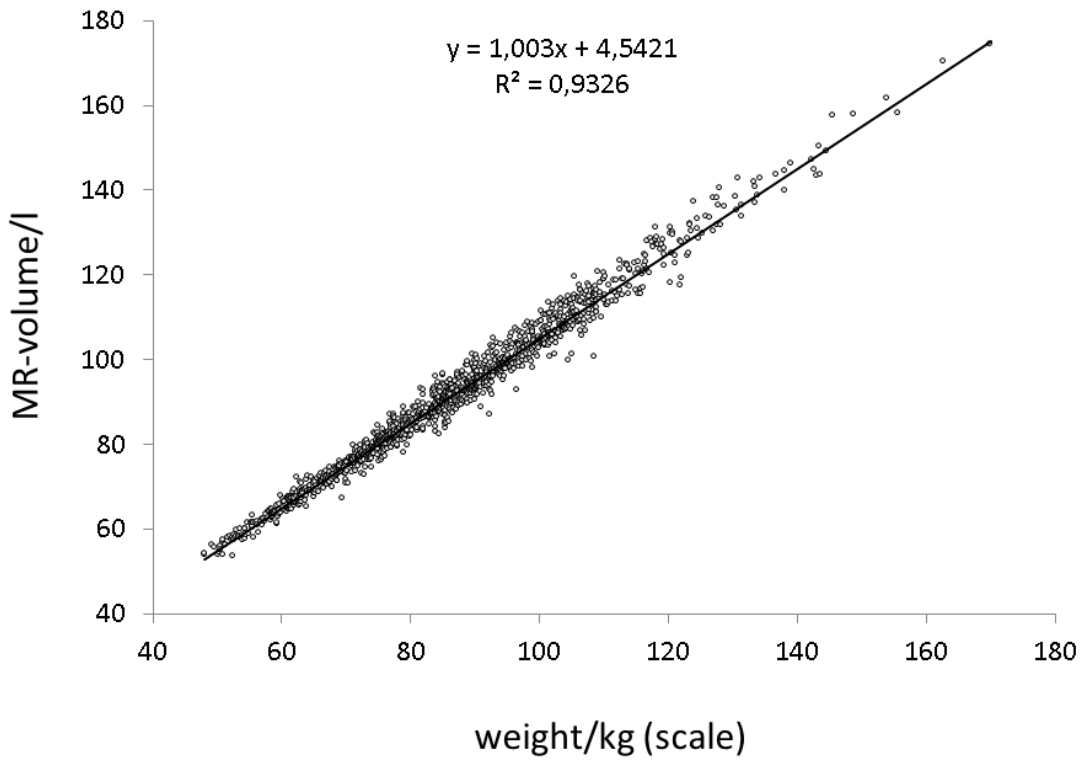

Figure S1: *Scatter plot of body weight vs. MR-derived volume after correction for fat density and inclusion of bone mass*