Electronic Supplementary Material (ESM)

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ESM Table 1. Associations between Body Fat Parameters and Ceramides

*Model adjusted for age, sex, race/ethnicity
†Model adjusted for age, sex, race/ethnicity, and body mass index
‡Model adjusted for age, sex, race/ethnicity, body mass index, and visceral fat

Ceramide	Fat Parameter	Beta (95% CI)	P-value*
C16:0	Body Mass Index	0.09 (0.03, 0.14)	0.0011
C18:0	Body Mass Index	0.19 (0.14, 0.24)	2.8×10^{-13}
C20:0	Body Mass Index	0.08 (0.02, 0.13)	0.0039
C22:1	Body Mass Index	0.05 (0.00, 0.10)	0.0417
C22:9	Body Mass Index	0.07 (0.02, 0.12)	0.0063
C22:10	Body Mass Index	0.23 (0.19, 0.28)	1.0×10^{-21}
C24:2	Body Mass Index	0.01 (-0.04, 0.07)	0.6168
C24:10	Body Mass Index	0.08 (0.02, 0.13)	0.0036
C26:9	Body Mass Index	-0.04 (-0.08, 0.01)	0.1630
C28:9	Body Mass Index	0.09 (0.05, 0.14)	1.4×10^{-04}
C30:9	Body Mass Index	0.06 (0.01, 0.11)	0.0146
C30:10	Body Mass Index	0.09 (0.04, 0.13)	6.1×10^{-04}
C32:11	Body Mass Index	0.07 (0.03, 0.12)	0.0031

Ceramide	Fat Parameter	Beta (95% CI)	P-value*	Beta (95% CI)	P-value†
C16:0	Total Abdominal Fat	0.11 (0.06, 0.16)	3.1×10^{-05}	0.20 (0.07, 0.34)	0.0026
C18:0	Total Abdominal Fat	0.21 (0.16, 0.26)	4.0×10^{-16}	0.24 (0.11, 0.37)	2.9×10^{-04}
C20:0	Total Abdominal Fat	0.10 (0.05, 0.15)	1.2×10^{-04}	0.20 (0.07, 0.34)	0.0023
C22:1	Total Abdominal Fat	0.08 (0.02, 0.13)	0.0037	0.18 (0.05, 0.31)	0.0074
C22:9	Total Abdominal Fat	0.08 (0.03, 0.13)	0.0018	0.10 (-0.03, 0.24)	0.1178
C22:10	Total Abdominal Fat	0.25 (0.21, 0.30)	3.8×10^{-26}	0.28 (0.16, 0.40)	6.5×10^{-06}
C24:2	Total Abdominal Fat	0.04 (-0.01, 0.10)	0.0955	0.22 (0.08, 0.35)	0.0016
C24:10	Total Abdominal Fat	0.08 (0.03, 0.13)	0.0010	0.11 (-0.02, 0.24)	0.1080
C26:9	Total Abdominal Fat	-0.03 (-0.08, 0.02)	0.2627	0.03 (-0.1, 0.16)	0.6580
C28:9	Total Abdominal Fat	0.11 (0.06, 0.16)	9.0×10^{-06}	0.16 (0.03, 0.28)	0.0152
C30:9	Total Abdominal Fat	0.08 (0.03, 0.13)	0.0011	0.18 (0.05, 0.31)	0.0076
C30:10	Total Abdominal Fat	0.10 (0.05, 0.15)	5.1×10^{-05}	0.15 (0.02, 0.28)	0.0207
C32:11	Total Abdominal Fat	0.10 (0.05, 0.15)	1.0×10^{-04}	0.20 (0.07, 0.32)	0.0026

Ceramide	Fat Parameter	Beta (95% CI)	P-value*	Beta (95% CI)	P-value†
C16:0	Visceral Fat/Total Fat	0.12 (0.03, 0.20)	0.0091	0.16 (0.07, 0.25)	3.6×10^{-04}
C18:0	Visceral Fat/Total Fat	0.10 (0.01, 0.18)	0.0306	0.18 (0.09, 0.27)	4.3×10^{-05}
C20:0	Visceral Fat/Total Fat	0.10 (0.02, 0.19)	0.0188	0.15 (0.06, 0.24)	0.0011
C22:1	Visceral Fat/Total Fat	0.05 (-0.04, 0.14)	0.2678	0.08 (-0.01, 0.17)	0.0842
C22:9	Visceral Fat/Total Fat	-0.08 (-0.16, 0.01)	0.0819	-0.05 (-0.14, 0.04)	0.2546
C22:10	Visceral Fat/Total Fat	-0.14 (-0.22, -0.06)	5.9×10^{-04}	-0.05 (-0.13, 0.03)	0.2062
C24:2	Visceral Fat/Total Fat	0.10 (0.01, 0.19)	0.0327	0.12 (0.02, 0.21)	0.0134
C24:10	Visceral Fat/Total Fat	-0.08 (-0.16, 0.01)	0.0715	-0.05 (-0.14, 0.04)	0.2514
C26:9	Visceral Fat/Total Fat	-0.11 (-0.20, -0.03)	0.0080	-0.13 (-0.22, -0.05)	0.0028
C28:9	Visceral Fat/Total Fat	-0.06 (-0.14, 0.02)	0.1475	-0.02 (-0.11, 0.07)	0.6459
C30:9	Visceral Fat/Total Fat	-0.05 (-0.13, 0.04)	0.2726	-0.02 (-0.11, 0.07)	0.6539
C30:10	Visceral Fat/Total Fat	-0.17 (-0.25, -0.09)	4.8×10^{-05}	-0.14 (-0.23, -0.06)	8.8×10^{-04}
C32:11	Visceral Fat/Total Fat	-0.18 (-0.27, -0.10)	1.5×10^{-05}	-0.16 (-0.25, -0.08)	1.7×10^{-04}

Ceramide	Fat Parameter	Beta (95% CI)	P-value*	Beta (95% CI)	P-value†
C16:0	Subcutaneous Fat/Total Fat	0.12 (0.07, 0.17)	8.6×10^{-06}	0.09 (0.04, 0.15)	0.0013
C18:0	Subcutaneous Fat/Total Fat	0.14 (0.09, 0.19)	1.1×10^{-07}	0.07 (0.02, 0.13)	0.0103
C20:0	Subcutaneous Fat/Total Fat	0.11 (0.06, 0.16)	3.2×10^{-05}	0.08 (0.03, 0.14)	0.0032
C22:1	Subcutaneous Fat/Total Fat	0.10 (0.04, 0.15)	2.9×10^{-04}	0.08 (0.03, 0.14)	0.0042
C22:9	Subcutaneous Fat/Total Fat	0.05 (0.00, 0.10)	0.0763	0.02 (-0.04, 0.08)	0.4738
C22:10	Subcutaneous Fat/Total Fat	0.12 (0.08, 0.17)	3.9×10^{-07}	0.03 (-0.02, 0.08)	0.2161
C24:2	Subcutaneous Fat/Total Fat	0.07 (0.02, 0.12)	0.0109	0.07 (0.01, 0.12)	0.0249
C24:10	Subcutaneous Fat/Total Fat	0.05 (0.00, 0.10)	0.0694	0.02 (-0.04, 0.07)	0.5114
C26:9	Subcutaneous Fat/Total Fat	0.00 (-0.05, 0.05)	0.8548	0.01 (-0.05, 0.06)	0.7650
C28:9	Subcutaneous Fat/Total Fat	0.08 (0.03, 0.13)	0.0010	0.05 (-0.01, 0.10)	0.0988
C30:9	Subcutaneous Fat/Total Fat	0.08 (0.03, 0.13)	0.0015	0.06 (0.01, 0.12)	0.0279
C30:10	Subcutaneous Fat/Total Fat	0.06 (0.01, 0.11)	0.0164	0.03 (-0.03, 0.08)	0.3102
C32:11	Subcutaneous Fat/Total Fat	0.06 (0.01, 0.11)	0.0138	0.04 (-0.02, 0.09)	0.1712

Ceramide	Fat Parameter	Beta (95% CI)	P-value*	Beta (95% CI)	P-value†
C16:0	Lower Fat/Total Fat	-0.15 (-0.22, -0.09)	1.4×10^{-06}	-0.13 (-0.19, -0.06)	1.2×10^{-04}
C18:0	Lower Fat/Total Fat	-0.24 (-0.31, -0.18)	1.9×10^{-14}	-0.19 (-0.25, -0.12)	1.3×10^{-08}
C20:0	Lower Fat/Total Fat	-0.16 (-0.22, -0.10)	4.6×10^{-07}	-0.14 (-0.2, -0.07)	4.0×10^{-05}
C22:1	Lower Fat/Total Fat	-0.10 (-0.16, -0.04)	0.0022	-0.08 (-0.15, -0.01)	0.0168
C22:9	Lower Fat/Total Fat	0.03 (-0.03, 0.09)	0.3067	0.07 (0.00, 0.13)	0.0459
C22:10	Lower Fat/Total Fat	-0.05 (-0.11, 0.00)	0.0696	0.04 (-0.02, 0.10)	0.1720
C24:2	Lower Fat/Total Fat	-0.07 (-0.14, -0.01)	0.0255	-0.07 (-0.14, 0.00)	0.0520
C24:10	Lower Fat/Total Fat	0.02 (-0.04, 0.08)	0.5026	0.06 (-0.01, 0.12)	0.0881
C26:9	Lower Fat/Total Fat	0.15 (0.09, 0.21)	1.3×10^{-06}	0.15 (0.09, 0.22)	2.2×10^{-06}
C28:9	Lower Fat/Total Fat	-0.06 (-0.13, 0.00)	0.0344	-0.03 (-0.09, 0.04)	0.4336
C30:9	Lower Fat/Total Fat	-0.02 (-0.09, 0.04)	0.4323	0.00 (-0.06, 0.07)	0.8982
C30:10	Lower Fat/Total Fat	0.08 (0.02, 0.14)	0.0139	0.12 (0.06, 0.19)	1.3×10^{-04}
C32:11	Lower Fat/Total Fat	0.08 (0.02, 0.14)	0.0071	0.12 (0.06, 0.19)	1.2×10^{-04}

Ceramide	Fat Parameter	Beta (95% CI)	P-value*	Beta (95% CI)	P-value†
C16:0	Liver Fat	0.05 (-0.01, 0.11)	0.0976	0.03 (-0.04, 0.09)	0.4003
C18:0	Liver Fat	0.15 (0.09, 0.20)	2.8×10^{-07}	0.10 (0.04, 0.16)	0.0010
C20:0	Liver Fat	0.07 (0.02, 0.13)	0.0115	0.05 (-0.01, 0.11)	0.1103
C22:1	Liver Fat	-0.03 (-0.08, 0.03)	0.3649	-0.04 (-0.10, 0.02)	0.1635
C22:9	Liver Fat	-0.04 (-0.10, 0.01)	0.1267	-0.08 (-0.14, -0.02)	0.0108
C22:10	Liver Fat	0.05 (-0.01, 0.10)	0.0811	-0.04 (-0.10, 0.02)	0.1603
C24:2	Liver Fat	-0.10 (-0.15, -0.04)	0.0010	-0.10 (-0.17, -0.04)	9.1×10^{-04}
C24:10	Liver Fat	-0.04 (-0.10, 0.02)	0.1524	-0.08 (-0.14, -0.02)	0.0099
C26:9	Liver Fat	-0.14 (-0.20, -0.09)	2.3×10^{-07}	-0.15 (-0.21, -0.09)	6.4×10^{-07}
C28:9	Liver Fat	0.03 (-0.03, 0.08)	0.3165	-0.01 (-0.07, 0.05)	0.7132
C30:9	Liver Fat	0.00 (-0.06, 0.05)	0.9163	-0.03 (-0.09, 0.03)	0.3657
C30:10	Liver Fat	-0.08 (-0.14, -0.03)	0.0032	-0.12 (-0.18, -0.06)	4.2×10^{-05}
C32:11	Liver Fat	-0.11 (-0.16, -0.05)	1.3×10^{-04}	-0.15 (-0.20, -0.09)	1.1×10^{-06}

Ceramide	Fat Parameter	Beta (95% CI)	P-value‡
C16:0	Liver Fat	0.01 (-0.05, 0.08)	0.6827
C18:0	Liver Fat	0.08 (0.02, 0.14)	0.0129
C20:0	Liver Fat	0.02 (-0.04, 0.09)	0.4442
C22:1	Liver Fat	-0.06 (-0.13, 0.00)	0.0492
C22:9	Liver Fat	-0.08 (-0.14, -0.02)	0.0135
C22:10	Liver Fat	-0.04 (-0.10, 0.02)	0.2121
C24:2	Liver Fat	-0.13 (-0.19, -0.07)	6.5×10^{-05}
C24:10	Liver Fat	-0.08 (-0.14, -0.02)	0.0108
C26:9	Liver Fat	-0.13 (-0.19, -0.07)	1.77×10^{-05}
C28:9	Liver Fat	-0.02 (-0.08, 0.04)	0.4795
C30:9	Liver Fat	-0.04 (-0.10, 0.02)	0.2306
C30:10	Liver Fat	-0.12 (-0.18, -0.06)	1.5×10^{-04}
C32:11	Liver Fat	-0.14 (-0.20, -0.08)	1.0×10^{-05}

Beta = beta-coefficient represents the difference in s.d. units in ceramide concentration per 1-standard deviation of the body fat depot; CI= confidence limit
P<0.0003 considered statistically significant.

ESM Table 2. Subgroup Analyses for Associations between Body Fat Parameters and Ceramides

Ceramide	Fat Parameter	Male			Female			P-interaction
		Beta	95% CI	P-value	Beta	95% CI	P-value	
C16:0	Visceral Fat/Total Fat	0.177	(0.070,0.283)	0.0012	0.122	(-0.050,0.293)	0.1651	0.7498
C18:0	Visceral Fat/Total Fat	0.170	(0.063,0.276)	0.0019	0.266	(0.102,0.429)	0.0015	0.1268
C20:0	Visceral Fat/Total Fat	0.158	(0.051,0.265)	0.0039	0.205	(0.038,0.373)	0.0164	0.1868
C22:1	Visceral Fat/Total Fat	0.097	(-0.007,0.202)	0.0671	0.093	(-0.085,0.270)	0.3061	0.6739
C22:9	Visceral Fat/Total Fat	0.025	(-0.081,0.131)	0.6437	-0.247	(-0.413,-0.080)	0.0038	0.0206
C22:10	Visceral Fat/Total Fat	0.029	(-0.064,0.122)	0.5406	-0.252	(-0.412,-0.092)	0.0020	0.0288
C24:2	Visceral Fat/Total Fat	0.084	(-0.027,0.195)	0.1404	0.185	(0.008,0.361)	0.0408	0.4881
C24:10	Visceral Fat/Total Fat	0.013	(-0.094,0.119)	0.8159	-0.224	(-0.391,-0.057)	0.0089	0.0286
C26:9	Visceral Fat/Total Fat	-0.040	(-0.141,0.061)	0.4410	-0.424	(-0.591,-0.257)	7.75×10^{-07}	7.26×10^{-05}
C28:9	Visceral Fat/Total Fat	0.066	(-0.035,0.168)	0.2022	-0.156	(-0.318,0.006)	0.0595	0.3850
C30:9	Visceral Fat/Total Fat	0.038	(-0.069,0.144)	0.4867	-0.113	(-0.281,0.056)	0.1897	0.5078
C30:10	Visceral Fat/Total Fat	-0.076	(-0.177,0.025)	0.1421	-0.325	(-0.487,-0.162)	9.52×10^{-05}	0.0237
C32:11	Visceral Fat/Total Fat	-0.115	(-0.216,-0.014)	0.0261	-0.313	(-0.476,-0.149)	1.9×10^{-04}	0.0485

Ceramide	Fat Parameter	Black			Non-Black			P-interaction
		Beta	95% CI	P-value	Beta	95% CI	P-value	
C16:0	Visceral Fat/Total Fat	0.264	(0.153,0.375)	3.7×10^{-06}	0.042	(-0.100,0.184)	0.5622	0.1200
C18:0	Visceral Fat/Total Fat	0.206	(0.093,0.318)	3.6×10^{-04}	0.152	(0.018,0.286)	0.0261	0.5029
C20:0	Visceral Fat/Total Fat	0.145	(0.030,0.259)	0.0135	0.127	(-0.011,0.265)	0.0715	0.8483
C22:1	Visceral Fat/Total Fat	0.112	(-0.005,0.230)	0.0606	0.027	(-0.112,0.166)	0.7066	0.0138
C22:9	Visceral Fat/Total Fat	-0.074	(-0.184,0.035)	0.1830	-0.054	(-0.198,0.090)	0.4633	0.1816
C22:10	Visceral Fat/Total Fat	-0.093	(-0.196,0.010)	0.0756	-0.036	(-0.167,0.095)	0.5877	0.3727
C24:2	Visceral Fat/Total Fat	0.161	(0.040,0.282)	0.0090	0.101	(-0.042,0.244)	0.1681	0.3268
C24:10	Visceral Fat/Total Fat	-0.064	(-0.174,0.046)	0.2549	-0.065	(-0.209,0.078)	0.3731	0.0890
C26:9	Visceral Fat/Total Fat	-0.131	(-0.241,-0.021)	0.0201	-0.174	(-0.312,-0.037)	0.0133	0.1875
C28:9	Visceral Fat/Total Fat	-0.042	(-0.153,0.069)	0.4563	-0.062	(-0.197,0.073)	0.3655	0.1328
C30:9	Visceral Fat/Total Fat	-0.04	(-0.152,0.072)	0.4819	-0.014	(-0.155,0.128)	0.8485	0.6913
C30:10	Visceral Fat/Total Fat	-0.123	(-0.228,-0.018)	0.0220	-0.19	(-0.328,-0.052)	0.0073	0.0043
C32:11	Visceral Fat/Total Fat	-0.119	(-0.226,-0.012)	0.0294	-0.235	(-0.372,-0.099)	7.7×10^{-04}	0.0145

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Ceramide	Fat Parameter	Age <50			Age≥50			
		Beta	95% CI	P-value	Beta	95% CI	P-value	P-interaction
C16:0	Visceral Fat/Total Fat	0.191	(0.088,0.293)	2.7×10^{-04}	0.167	(-0.001,0.334)	0.0520	0.0228
C18:0	Visceral Fat/Total Fat	0.201	(0.101,0.300)	8.3×10^{-05}	0.189	(0.023,0.356)	0.0266	0.0757
C20:0	Visceral Fat/Total Fat	0.141	(0.037,0.244)	0.0077	0.206	(0.043,0.369)	0.0136	0.1046
C22:1	Visceral Fat/Total Fat	0.053	(-0.052,0.158)	0.3195	0.179	(0.009,0.348)	0.0393	0.1455
C22:9	Visceral Fat/Total Fat	-0.059	(-0.160,0.042)	0.2549	0.036	(-0.133,0.205)	0.6780	0.1585
C22:10	Visceral Fat/Total Fat	-0.037	(-0.130,0.057)	0.4432	0.017	(-0.140,0.174)	0.8283	0.0042
C24:2	Visceral Fat/Total Fat	0.117	(0.010,0.224)	0.0329	0.152	(-0.026,0.330)	0.0949	0.1732
C24:10	Visceral Fat/Total Fat	-0.057	(-0.158,0.045)	0.2732	0.033	(-0.137,0.202)	0.7066	0.0855
C26:9	Visceral Fat/Total Fat	-0.168	(-0.268,-0.068)	9.9×10^{-04}	-0.009	(-0.173,0.156)	0.9188	0.9191
C28:9	Visceral Fat/Total Fat	-0.068	(-0.167,0.030)	0.1733	0.165	(0.005,0.325)	0.0435	0.0862
C30:9	Visceral Fat/Total Fat	-0.042	(-0.143,0.059)	0.4161	0.08	(-0.092,0.252)	0.3633	0.0646
C30:10	Visceral Fat/Total Fat	-0.18	(-0.277,-0.082)	3.2×10^{-04}	0.008	(-0.154,0.170)	0.9247	0.0638
C32:11	Visceral Fat/Total Fat	-0.188	(-0.287,-0.089)	2.0×10^{-04}	-0.048	(-0.205,0.109)	0.5482	0.1066

Ceramide	Fat Parameter	Non-Obese			Obese			
		Beta	95% CI	P-value	Beta	95% CI	P-value	P-interaction
C16:0	Visceral Fat/Total Fat	0.191	(0.086,0.295)	3.6×10^{-04}	0.126	(-0.038,0.291)	0.1316	0.1500
C18:0	Visceral Fat/Total Fat	0.229	(0.127,0.331)	1.2×10^{-05}	0.057	(-0.105,0.219)	0.4923	0.0567
C20:0	Visceral Fat/Total Fat	0.203	(0.099,0.306)	1.3×10^{-04}	0.051	(-0.115,0.216)	0.5504	0.6410
C22:1	Visceral Fat/Total Fat	0.121	(0.013,0.229)	0.0279	0.004	(-0.156,0.165)	0.9580	0.0205
C22:9	Visceral Fat/Total Fat	-0.01	(-0.113,0.093)	0.8531	-0.102	(-0.264,0.060)	0.2178	0.1830
C22:10	Visceral Fat/Total Fat	0.005	(-0.092,0.101)	0.9220	-0.192	(-0.346,-0.039)	0.0145	0.0037
C24:2	Visceral Fat/Total Fat	0.169	(0.063,0.276)	0.0019	0.000	(-0.174,0.174)	0.9976	1.4×10^{-04}
C24:10	Visceral Fat/Total Fat	-0.017	(-0.120,0.086)	0.7493	-0.082	(-0.245,0.081)	0.3262	0.1785
C26:9	Visceral Fat/Total Fat	-0.083	(-0.184,0.019)	0.1115	-0.218	(-0.373,-0.062)	0.0062	0.0048
C28:9	Visceral Fat/Total Fat	0.032	(-0.071,0.134)	0.5454	-0.095	(-0.245,0.055)	0.2147	0.4718
C30:9	Visceral Fat/Total Fat	0.028	(-0.076,0.132)	0.5976	-0.086	(-0.248,0.077)	0.3024	0.4704
C30:10	Visceral Fat/Total Fat	-0.089	(-0.191,0.014)	0.0897	-0.249	(-0.398,-0.100)	0.0011	0.0014
C32:11	Visceral Fat/Total Fat	-0.104	(-0.205,-0.003)	0.0441	-0.286	(-0.438,-0.134)	2.4×10^{-04}	1.5×10^{-04}

		Male			Female			
Ceramide	Fat Parameter	Beta	95% CI	P-value	Beta	95% CI	P-value	P-interaction
C16:0	Lower Fat/Total Fat	-0.124	(-0.237,-0.012)	0.0305	-0.129	(-0.211,-0.048)	0.0020	0.9964
C18:0	Lower Fat/Total Fat	-0.15	(-0.262,-0.038)	0.0091	-0.223	(-0.301,-0.144)	3.3×10^{-08}	0.4710
C20:0	Lower Fat/Total Fat	-0.108	(-0.218,0.003)	0.0560	-0.174	(-0.254,-0.093)	2.6×10^{-05}	0.8401
C22:1	Lower Fat/Total Fat	-0.026	(-0.135,0.083)	0.6385	-0.115	(-0.20,-0.030)	0.0080	0.4546
C22:9	Lower Fat/Total Fat	0.046	(-0.065,0.157)	0.4129	0.086	(0.005,0.166)	0.0373	0.6160
C22:10	Lower Fat/Total Fat	0.012	(-0.084,0.109)	0.8015	0.066	(-0.011,0.143)	0.0954	0.8012
C24:2	Lower Fat/Total Fat	0.087	(-0.028,0.202)	0.1406	-0.146	(-0.231,-0.061)	8.2×10^{-04}	0.0014
C24:10	Lower Fat/Total Fat	0.039	(-0.072,0.150)	0.4925	0.076	(-0.005,0.157)	0.0660	0.5805
C26:9	Lower Fat/Total Fat	0.165	(0.060,0.270)	0.0021	0.158	(0.077,0.239)	1.4×10^{-04}	0.8928
C28:9	Lower Fat/Total Fat	-0.011	(-0.117,0.096)	0.8453	-0.048	(-0.126,0.030)	0.2315	0.9175
C30:9	Lower Fat/Total Fat	0.02	(-0.092,0.131)	0.7289	-0.016	(-0.097,0.065)	0.7022	0.8095
C30:10	Lower Fat/Total Fat	0.161	(0.056,0.266)	0.0028	0.111	(0.033,0.190)	0.0057	0.4433
C32:11	Lower Fat/Total Fat	0.199	(0.094,0.304)	2.1×10^{-04}	0.095	(0.016,0.174)	0.0184	0.0611

		Black			Non-Black			
Ceramide	Fat Parameter	Beta	95% CI	P-value	Beta	95% CI	P-value	P-interaction
C16:0	Lower Fat/Total Fat	-0.229	(-0.313,-0.145)	1.3×10^{-07}	-0.03	(-0.131,0.070)	0.5539	0.0275
C18:0	Lower Fat/Total Fat	-0.27	(-0.355,-0.184)	1.1×10^{-09}	-0.091	(-0.185,0.002)	0.0567	0.0866
C20:0	Lower Fat/Total Fat	-0.177	(-0.263,-0.091)	5.9×10^{-05}	-0.059	(-0.156,0.037)	0.2286	0.1854
C22:1	Lower Fat/Total Fat	-0.113	(-0.202,-0.025)	0.0122	-0.027	(-0.124,0.071)	0.5922	0.1957
C22:9	Lower Fat/Total Fat	0.07	(-0.013,0.154)	0.0984	0.099	(-0.002,0.199)	0.0543	0.6022
C22:10	Lower Fat/Total Fat	0.049	(-0.030,0.127)	0.2251	0.079	(-0.013,0.170)	0.0913	0.6987
C24:2	Lower Fat/Total Fat	-0.115	(-0.206,-0.024)	0.0137	-0.046	(-0.146,0.054)	0.3703	0.6117
C24:10	Lower Fat/Total Fat	0.044	(-0.040,0.128)	0.3020	0.106	(0.006,0.206)	0.0382	0.2702
C26:9	Lower Fat/Total Fat	0.171	(0.088,0.255)	6.4×10^{-05}	0.17	(0.074,0.265)	0.0005	0.5956
C28:9	Lower Fat/Total Fat	0.007	(-0.078,0.091)	0.8757	0.008	(-0.087,0.102)	0.8731	0.9647
C30:9	Lower Fat/Total Fat	-0.002	(-0.087,0.084)	0.9686	0.035	(-0.063,0.134)	0.4824	0.4141
C30:10	Lower Fat/Total Fat	0.1	(0.020,0.181)	0.0144	0.167	(0.071,0.263)	7.2×10^{-04}	0.1277
C32:11	Lower Fat/Total Fat	0.103	(0.022,0.185)	0.0133	0.16	(0.065,0.255)	0.0011	0.3765

Ceramide	Fat Parameter	Age <50			Age≥50			P-interaction
		Beta	95% CI	P-value	Beta	95% CI	P-value	
C16:0	Lower Fat/Total Fat	-0.144	(-0.219,-0.069)	1.8×10^{-04}	-0.134	(-0.265,-0.003)	0.0455	0.2998
C18:0	Lower Fat/Total Fat	-0.189	(-0.263,-0.115)	6.3×10^{-07}	-0.215	(-0.342,-0.089)	9.4×10^{-04}	0.8452
C20:0	Lower Fat/Total Fat	-0.13	(-0.207,-0.054)	8.0×10^{-04}	-0.187	(-0.309,-0.065)	0.0028	0.9766
C22:1	Lower Fat/Total Fat	-0.074	(-0.150,0.003)	0.0605	-0.127	(-0.257,0.003)	0.0553	0.7085
C22:9	Lower Fat/Total Fat	0.03	(-0.045,0.105)	0.4294	0.13	(0.001,0.258)	0.0485	0.0421
C22:10	Lower Fat/Total Fat	-0.005	(-0.074,0.064)	0.8911	0.11	(-0.009,0.229)	0.0713	0.0011
C24:2	Lower Fat/Total Fat	-0.093	(-0.172,-0.015)	0.0201	-0.026	(-0.161,0.108)	0.7007	0.1740
C24:10	Lower Fat/Total Fat	0.024	(-0.050,0.099)	0.5232	0.106	(-0.023,0.234)	0.1091	0.0392
C26:9	Lower Fat/Total Fat	0.151	(0.077,0.225)	6.1×10^{-05}	0.147	(0.022,0.271)	0.0214	0.4670
C28:9	Lower Fat/Total Fat	-0.024	(-0.097,0.048)	0.5098	-0.049	(-0.171,0.074)	0.4341	0.1005
C30:9	Lower Fat/Total Fat	-0.001	(-0.076,0.073)	0.9741	-0.006	(-0.138,0.125)	0.9239	0.1983
C30:10	Lower Fat/Total Fat	0.096	(0.024,0.168)	0.0095	0.166	(0.043,0.288)	0.0082	0.0082
C32:11	Lower Fat/Total Fat	0.098	(0.025,0.172)	0.0087	0.174	(0.055,0.293)	0.0043	0.0191

Ceramide	Fat Parameter	Non-Obese			Obese			P-interaction
		Beta	95% CI	P-value	Beta	95% CI	P-value	
C16:0	Lower Fat/Total Fat	-0.174	(-0.250,-0.098)	8.1×10^{-06}	-0.088	(-0.208,0.031)	0.1469	0.1454
C18:0	Lower Fat/Total Fat	-0.267	(-0.341,-0.193)	3.2×10^{-12}	-0.086	(-0.204,0.031)	0.1506	0.0239
C20:0	Lower Fat/Total Fat	-0.18	(-0.255,-0.105)	2.8×10^{-06}	-0.12	(-0.238,-0.002)	0.0472	0.8919
C22:1	Lower Fat/Total Fat	-0.121	(-0.198,-0.043)	0.0024	-0.028	(-0.145,0.090)	0.6463	0.0308
C22:9	Lower Fat/Total Fat	0.023	(-0.053,0.099)	0.5522	0.06	(-0.057,0.177)	0.3181	0.2666
C22:10	Lower Fat/Total Fat	-0.044	(-0.115,0.026)	0.2205	0.027	(-0.085,0.138)	0.6358	0.0247
C24:2	Lower Fat/Total Fat	-0.119	(-0.196,-0.041)	0.0027	0.063	(-0.063,0.189)	0.3247	1.3×10^{-04}
C24:10	Lower Fat/Total Fat	0.006	(-0.070,0.081)	0.8851	0.071	(-0.046,0.189)	0.2354	0.1152
C26:9	Lower Fat/Total Fat	0.137	(0.063,0.211)	3.1×10^{-04}	0.174	(0.062,0.286)	0.0024	0.0148
C28:9	Lower Fat/Total Fat	-0.086	(-0.161,-0.010)	0.0260	-0.004	(-0.112,0.104)	0.9440	0.1975
C30:9	Lower Fat/Total Fat	-0.026	(-0.103,0.050)	0.5032	-0.001	(-0.118,0.117)	0.9932	0.6956
C30:10	Lower Fat/Total Fat	0.053	(-0.022,0.128)	0.1665	0.199	(0.091,0.306)	3.1×10^{-04}	2.2×10^{-04}
C32:11	Lower Fat/Total Fat	0.06	(-0.014,0.135)	0.1106	0.204	(0.095,0.314)	2.8×10^{-04}	7.6×10^{-05}

Beta = beta-coefficient represents the difference in s.d. units in ceramide concentration per 1-standard deviation of the body fat depot; CI= confidence limit; P<0.0003 considered statistically significant.

ESM Table 3. Associations between Ceramides and Non-Alcoholic Fatty Liver Disease (NAFLD)

Ceramide	Fat Parameter	Odds Ratio	95% CI	P-value
C16:0	NAFLD	1.054	0.893,1.245	0.5340
C18:0	NAFLD	1.152	0.978,1.356	0.0901
C20:0	NAFLD	1.068	0.924,1.235	0.3726
C22:1	NAFLD	0.97	0.823,1.143	0.7125
C22:9	NAFLD	0.755	0.626,0.911	0.0033
C22:10	NAFLD	0.764	0.611,0.957	0.0190
C24:2	NAFLD	0.812	0.658,1.002	0.0517
C24:10	NAFLD	0.773	0.64,0.933	0.0074
C26:9	NAFLD	0.955	0.796,1.146	0.6224
C28:9	NAFLD	0.898	0.743,1.086	0.2671
C30:9	NAFLD	0.846	0.705,1.015	0.0712
C30:10	NAFLD	0.638	0.526,0.774	5.16×10^{-06}
C32:11	NAFLD	0.652	0.54,0.786	7.76×10^{-06}

Odds ratio represents the odds of NAFLD per 1-SD increase in ceramide concentration.
P<0.0003 considered statistically significant. NALFD = non-alcoholic fatty liver disease

ESM Table 4. Associations between Body Fat Parameters and Ceramide Ratios

Ceramide Ratio	Fat Parameter	Beta (95% CI)	P-value[†]
C16:0/C18:0	Visceral Fat/Total Fat	-0.02 (-0.11, 0.07)	0.6297
C16:0/C20:0	Visceral Fat/Total Fat	0.03 (-0.07, 0.12)	0.5697
C16:0/C22:1	Visceral Fat/Total Fat	0.13 (0.03, 0.22)	0.0086
C16:0/C22:9	Visceral Fat/Total Fat	0.18 (0.09, 0.27)	6.9×10^{-05}
C16:0/C22:10	Visceral Fat/Total Fat	0.15 (0.06, 0.24)	8.5×10^{-04}
C16:0/C24:2	Visceral Fat/Total Fat	0.12 (0.03, 0.22)	0.0114
C16:0/C24:10	Visceral Fat/Total Fat	0.1 (0.02, 0.19)	0.0208
C16:0/C26:9	Visceral Fat/Total Fat	0.31 (0.22, 0.39)	6.0×10^{-12}
C16:0/C28:9	Visceral Fat/Total Fat	0.17 (0.08, 0.26)	1.8×10^{-04}
C16:0/C30:9	Visceral Fat/Total Fat	0.2 (0.1, 0.29)	2.4×10^{-05}
C16:0/C30:10	Visceral Fat/Total Fat	0.29 (0.2, 0.38)	8.9×10^{-11}
C16:0/C32:11	Visceral Fat/Total Fat	0.3 (0.22, 0.39)	1.4×10^{-11}
C18:0/C20:0	Visceral Fat/Total Fat	0.09 (0, 0.18)	0.0477
C18:0/C22:1	Visceral Fat/Total Fat	0.18 (0.09, 0.27)	1.6×10^{-04}
C18:0/C22:9	Visceral Fat/Total Fat	0.12 (0.03, 0.21)	0.0084
C18:0/C22:10	Visceral Fat/Total Fat	0.13 (0.05, 0.22)	0.0029
C18:0/C24:2	Visceral Fat/Total Fat	0.19 (0.1, 0.28)	7.4×10^{-05}
C18:0/C24:10	Visceral Fat/Total Fat	0.07 (-0.02, 0.16)	0.1159
C18:0/C26:9	Visceral Fat/Total Fat	0.23 (0.14, 0.31)	4.0×10^{-07}
C18:0/C28:9	Visceral Fat/Total Fat	0.16 (0.07, 0.25)	3.5×10^{-04}
C18:0/C30:9	Visceral Fat/Total Fat	0.21 (0.13, 0.3)	2.1×10^{-06}
C18:0/C30:10	Visceral Fat/Total Fat	0.24 (0.15, 0.33)	6.1×10^{-08}
C18:0/C32:11	Visceral Fat/Total Fat	0.25 (0.16, 0.34)	2.1×10^{-08}
C20:0/C22:1	Visceral Fat/Total Fat	0.13 (0.04, 0.22)	0.0062
C20:0/C22:9	Visceral Fat/Total Fat	0.07 (-0.02, 0.16)	0.1401
C20:0/C22:10	Visceral Fat/Total Fat	0.1 (0.01, 0.19)	0.0288
C20:0/C24:2	Visceral Fat/Total Fat	0.12 (0.03, 0.22)	0.0081
C20:0/C24:10	Visceral Fat/Total Fat	0.03 (-0.06, 0.12)	0.5364
C20:0/C26:9	Visceral Fat/Total Fat	0.16 (0.07, 0.25)	4.8×10^{-04}
C20:0/C28:9	Visceral Fat/Total Fat	0.1 (0.01, 0.19)	0.0363
C20:0/C30:9	Visceral Fat/Total Fat	0.16 (0.07, 0.24)	6.9×10^{-04}
C20:0/C30:10	Visceral Fat/Total Fat	0.16 (0.07, 0.25)	4.2×10^{-04}
C20:0/C32:11	Visceral Fat/Total Fat	0.16 (0.08, 0.25)	2.8×10^{-04}
C22:1/C22:9	Visceral Fat/Total Fat	0.01 (-0.08, 0.1)	0.8103
C22:1/C22:10	Visceral Fat/Total Fat	0.03 (-0.06, 0.13)	0.4559
C22:1/C24:2	Visceral Fat/Total Fat	0.03 (-0.07, 0.12)	0.5773
C22:1/C24:10	Visceral Fat/Total Fat	-0.03 (-0.12, 0.06)	0.5111
C22:1/C26:9	Visceral Fat/Total Fat	0.1 (0.01, 0.19)	0.0350
C22:1/C28:9	Visceral Fat/Total Fat	-0.01 (-0.1, 0.08)	0.8469
C22:1/C30:9	Visceral Fat/Total Fat	0.04 (-0.05, 0.14)	0.3477
C22:1/C30:10	Visceral Fat/Total Fat	0.09 (0.01, 0.18)	0.0387
C22:1/C32:11	Visceral Fat/Total Fat	0.09 (0, 0.18)	0.0453
C22:9/C22:10	Visceral Fat/Total Fat	0.04 (-0.04, 0.12)	0.3507

Ceramide Ratio	Fat Parameter	Beta (95% CI)	P-value
C22:9/C24:2	Visceral Fat/Total Fat	0 (-0.09, 0.1)	0.9716
C22:9/C24:10	Visceral Fat/Total Fat	-0.12 (-0.21, -0.03)	0.0063
C22:9/C26:9	Visceral Fat/Total Fat	0.17 (0.08, 0.26)	1.1×10^{-04}
C22:9/C28:9	Visceral Fat/Total Fat	0.01 (-0.07, 0.1)	0.7519
C22:9/C30:9	Visceral Fat/Total Fat	0.05 (-0.04, 0.14)	0.2531
C22:9/C30:10	Visceral Fat/Total Fat	0.13 (0.04, 0.22)	0.0038
C22:9/C32:11	Visceral Fat/Total Fat	0.12 (0.03, 0.21)	0.0069
C22:10/C24:2	Visceral Fat/Total Fat	-0.02 (-0.11, 0.07)	0.6524
C22:10/C24:10	Visceral Fat/Total Fat	-0.1 (-0.19, -0.02)	0.0172
C22:10/C26:9	Visceral Fat/Total Fat	0.06 (-0.03, 0.14)	0.1703
C22:10/C28:9	Visceral Fat/Total Fat	-0.02 (-0.1, 0.07)	0.6912
C22:10/C30:9	Visceral Fat/Total Fat	0.01 (-0.08, 0.1)	0.8536
C22:10/C30:10	Visceral Fat/Total Fat	0.06 (-0.02, 0.15)	0.1631
C22:10/C32:11	Visceral Fat/Total Fat	0.06 (-0.03, 0.14)	0.2050
C24:2/C24:10	Visceral Fat/Total Fat	-0.04 (-0.13, 0.05)	0.4159
C24:2/C26:9	Visceral Fat/Total Fat	0.08 (-0.01, 0.17)	0.0905
C24:2/C28:9	Visceral Fat/Total Fat	-0.02 (-0.11, 0.07)	0.6524
C24:2/C30:9	Visceral Fat/Total Fat	0.03 (-0.07, 0.12)	0.5626
C24:2/C30:10	Visceral Fat/Total Fat	0.07 (-0.02, 0.17)	0.1208
C24:2/C32:11	Visceral Fat/Total Fat	0.07 (-0.02, 0.16)	0.1289
C24:10/C26:9	Visceral Fat/Total Fat	0.21 (0.12, 0.3)	2.1×10^{-06}
C24:10/C28:9	Visceral Fat/Total Fat	0.06 (-0.02, 0.15)	0.1482
C24:10/C30:9	Visceral Fat/Total Fat	0.08 (0, 0.17)	0.0635
C24:10/C30:10	Visceral Fat/Total Fat	0.16 (0.07, 0.25)	3.8×10^{-04}
C24:10/C32:11	Visceral Fat/Total Fat	0.17 (0.08, 0.25)	2.1×10^{-04}
C26:9/C28:9	Visceral Fat/Total Fat	-0.12 (-0.21, -0.04)	0.0056
C26:9/C30:9	Visceral Fat/Total Fat	-0.04 (-0.13, 0.05)	0.3501
C26:9/C30:10	Visceral Fat/Total Fat	-0.01 (-0.1, 0.08)	0.8160
C26:9/C32:11	Visceral Fat/Total Fat	-0.01 (-0.1, 0.08)	0.8223
C28:9/C30:9	Visceral Fat/Total Fat	0.07 (-0.02, 0.16)	0.1119
C28:9/C30:10	Visceral Fat/Total Fat	0.17 (0.09, 0.25)	4.3×10^{-05}
C28:9/C32:11	Visceral Fat/Total Fat	0.14 (0.06, 0.22)	9.0×10^{-04}
C30:9/C30:10	Visceral Fat/Total Fat	0.05 (-0.03, 0.14)	0.2238
C30:9/C32:11	Visceral Fat/Total Fat	0.05 (-0.04, 0.14)	0.2480
C30:10/C32:11	Visceral Fat/Total Fat	0 (-0.09, 0.09)	0.9483

Ceramide Ratio	Fat Parameter	Beta (95% CI)	P-value**
C16:0/C18:0	Lower Fat/Total Fat	0.13 (0.06, 0.2)	1.7×10^{-04}
C16:0/C20:0	Lower Fat/Total Fat	0.08 (0.01, 0.14)	0.0297
C16:0/C22:1	Lower Fat/Total Fat	-0.02 (-0.09, 0.05)	0.6213
C16:0/C22:9	Lower Fat/Total Fat	-0.2 (-0.26, -0.13)	6.2×10^{-09}
C16:0/C22:10	Lower Fat/Total Fat	-0.1 (-0.16, -0.03)	0.0039
C16:0/C24:2	Lower Fat/Total Fat	-0.01 (-0.08, 0.06)	0.8283
C16:0/C24:10	Lower Fat/Total Fat	-0.16 (-0.23, -0.1)	1.0×10^{-06}
C16:0/C26:9	Lower Fat/Total Fat	-0.26 (-0.32, -0.19)	6.4×10^{-15}

C16:0/C28:9	Lower Fat/Total Fat	-0.09 (-0.15, -0.02)	0.0096
C16:0/C30:9	Lower Fat/Total Fat	-0.09 (-0.15, -0.02)	0.0119
C16:0/C30:10	Lower Fat/Total Fat	-0.21 (-0.27, -0.14)	6.9×10^{-10}
C16:0/C32:11	Lower Fat/Total Fat	-0.2 (-0.27, -0.14)	1.1×10^{-09}
C18:0/C20:0	Lower Fat/Total Fat	-0.04 (-0.11, 0.02)	0.1782
C18:0/C22:1	Lower Fat/Total Fat	-0.16 (-0.23, -0.09)	3.5×10^{-06}
C18:0/C22:9	Lower Fat/Total Fat	-0.21 (-0.28, -0.15)	3.1×10^{-10}
C18:0/C22:10	Lower Fat/Total Fat	-0.16 (-0.22, -0.09)	3.1×10^{-06}
C18:0/C24:2	Lower Fat/Total Fat	-0.16 (-0.22, -0.09)	1.1×10^{-05}
C18:0/C24:10	Lower Fat/Total Fat	-0.19 (-0.25, -0.12)	1.7×10^{-08}
C18:0/C26:9	Lower Fat/Total Fat	-0.27 (-0.34, -0.21)	9.0×10^{-17}
C18:0/C28:9	Lower Fat/Total Fat	-0.18 (-0.25, -0.12)	4.0×10^{-08}
C18:0/C30:9	Lower Fat/Total Fat	-0.2 (-0.27, -0.14)	1.6×10^{-09}
C18:0/C30:10	Lower Fat/Total Fat	-0.27 (-0.34, -0.21)	3.4×10^{-16}
C18:0/C32:11	Lower Fat/Total Fat	-0.27 (-0.33, -0.2)	5.7×10^{-16}
C20:0/C22:1	Lower Fat/Total Fat	-0.13 (-0.2, -0.07)	1.2×10^{-04}
C20:0/C22:9	Lower Fat/Total Fat	-0.17 (-0.23, -0.1)	1.1×10^{-06}
C20:0/C22:10	Lower Fat/Total Fat	-0.14 (-0.2, -0.07)	6.8×10^{-05}
C20:0/C24:2	Lower Fat/Total Fat	-0.11 (-0.18, -0.04)	0.0016
C20:0/C24:10	Lower Fat/Total Fat	-0.15 (-0.21, -0.08)	1.2×10^{-05}
C20:0/C26:9	Lower Fat/Total Fat	-0.22 (-0.28, -0.15)	5.2×10^{-11}
C20:0/C28:9	Lower Fat/Total Fat	-0.16 (-0.22, -0.09)	4.6×10^{-06}
C20:0/C30:9	Lower Fat/Total Fat	-0.18 (-0.25, -0.12)	6.9×10^{-08}
C20:0/C30:10	Lower Fat/Total Fat	-0.21 (-0.27, -0.14)	2.8×10^{-10}
C20:0/C32:11	Lower Fat/Total Fat	-0.2 (-0.27, -0.14)	5.9×10^{-10}
C22:1/C22:9	Lower Fat/Total Fat	-0.11 (-0.17, -0.04)	0.0019
C22:1/C22:10	Lower Fat/Total Fat	-0.06 (-0.13, 0)	0.0681
C22:1/C24:2	Lower Fat/Total Fat	0 (-0.07, 0.06)	0.9104
C22:1/C24:10	Lower Fat/Total Fat	-0.09 (-0.15, -0.02)	0.0126
C22:1/C26:9	Lower Fat/Total Fat	-0.16 (-0.23, -0.1)	1.5×10^{-06}
C22:1/C28:9	Lower Fat/Total Fat	-0.06 (-0.13, 0.01)	0.0703
C22:1/C30:9	Lower Fat/Total Fat	-0.07 (-0.14, 0)	0.0357
C22:1/C30:10	Lower Fat/Total Fat	-0.16 (-0.23, -0.1)	9.7×10^{-07}
C22:1/C32:11	Lower Fat/Total Fat	-0.15 (-0.22, -0.09)	5.4×10^{-06}
C22:9/C22:10	Lower Fat/Total Fat	0.02 (-0.04, 0.09)	0.4308
C22:9/C24:2	Lower Fat/Total Fat	0.11 (0.04, 0.18)	0.0021
C22:9/C24:10	Lower Fat/Total Fat	0.03 (-0.03, 0.1)	0.3003
C22:9/C26:9	Lower Fat/Total Fat	-0.1 (-0.17, -0.04)	0.0018
C22:9/C28:9	Lower Fat/Total Fat	0.07 (0.01, 0.14)	0.0293
C22:9/C30:9	Lower Fat/Total Fat	0.05 (-0.02, 0.11)	0.1579
C22:9/C30:10	Lower Fat/Total Fat	-0.03 (-0.09, 0.04)	0.3850
C22:9/C32:11	Lower Fat/Total Fat	-0.01 (-0.08, 0.05)	0.7299
C22:10/C24:2	Lower Fat/Total Fat	0.08 (0.01, 0.14)	0.0298
C22:10/C24:10	Lower Fat/Total Fat	0 (-0.06, 0.07)	0.8816
C22:10/C26:9	Lower Fat/Total Fat	-0.07 (-0.14, -0.01)	0.0205
C22:10/C28:9	Lower Fat/Total Fat	0.02 (-0.04, 0.09)	0.4584

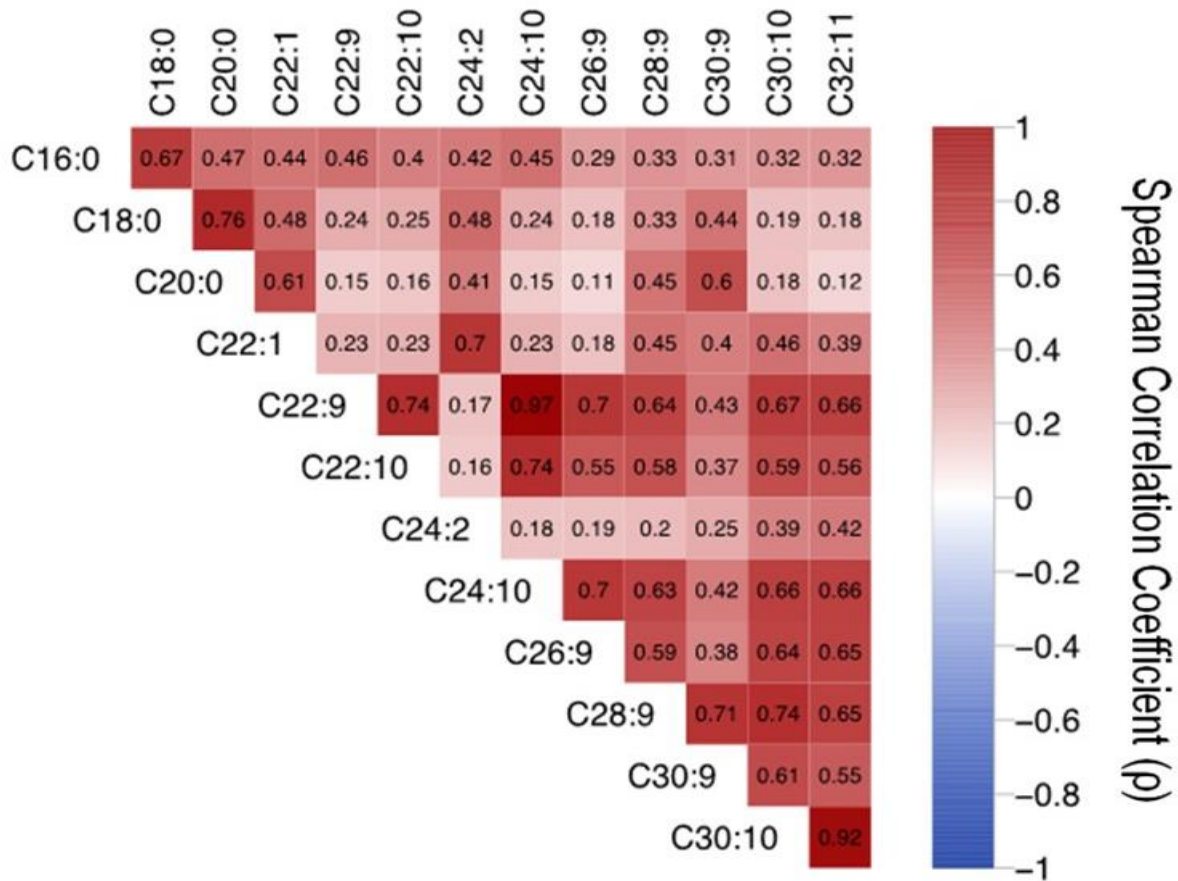|			
C22:10/C30:9	Lower Fat/Total Fat	0.02 (-0.05, 0.08)	0.6160
C22:10/C30:10	Lower Fat/Total Fat	-0.05 (-0.12, 0.01)	0.1009
C22:10/C32:11	Lower Fat/Total Fat	-0.04 (-0.1, 0.02)	0.2239
C24:2/C24:10	Lower Fat/Total Fat	-0.09 (-0.15, -0.02)	0.0135
C24:2/C26:9	Lower Fat/Total Fat	-0.15 (-0.22, -0.09)	8.8×10^{-06}
C24:2/C28:9	Lower Fat/Total Fat	-0.06 (-0.13, 0.01)	0.0907
C24:2/C30:9	Lower Fat/Total Fat	-0.07 (-0.14, 0)	0.0560
C24:2/C30:10	Lower Fat/Total Fat	-0.15 (-0.22, -0.08)	1.5×10^{-05}
C24:2/C32:11	Lower Fat/Total Fat	-0.14 (-0.21, -0.08)	3.0×10^{-05}
C24:10/C26:9	Lower Fat/Total Fat	-0.1 (-0.16, -0.03)	0.0033
C24:10/C28:9	Lower Fat/Total Fat	0.04 (-0.02, 0.11)	0.2183
C24:10/C30:9	Lower Fat/Total Fat	0.03 (-0.03, 0.1)	0.3615
C24:10/C30:10	Lower Fat/Total Fat	-0.05 (-0.11, 0.02)	0.1377
C24:10/C32:11	Lower Fat/Total Fat	-0.03 (-0.1, 0.03)	0.3309
C26:9/C28:9	Lower Fat/Total Fat	0.16 (0.1, 0.23)	4.8×10^{-07}
C26:9/C30:9	Lower Fat/Total Fat	0.11 (0.04, 0.17)	0.0014
C26:9/C30:10	Lower Fat/Total Fat	0.06 (0, 0.13)	0.0686
C26:9/C32:11	Lower Fat/Total Fat	0.07 (0.01, 0.14)	0.0309
C28:9/C30:9	Lower Fat/Total Fat	-0.01 (-0.07, 0.06)	0.7932
C28:9/C30:10	Lower Fat/Total Fat	-0.18 (-0.24, -0.12)	1.8×10^{-09}
C28:9/C32:11	Lower Fat/Total Fat	-0.14 (-0.2, -0.08)	8.0×10^{-06}
C30:9/C30:10	Lower Fat/Total Fat	-0.11 (-0.18, -0.05)	5.9×10^{-04}
C30:9/C32:11	Lower Fat/Total Fat	-0.09 (-0.16, -0.03)	0.0043
C30:10/C32:11	Lower Fat/Total Fat	0.01 (-0.05, 0.08)	0.6867

Beta = beta-coefficient represents the difference in s.d. units in ceramide concentration per 1-standard deviation of the body fat depot; CI= confidence limit
P<0.0003 considered statistically significant.

ESM Table 5. Associations of Ceramides with Incident HOMA-IR (>3) at Follow-Up

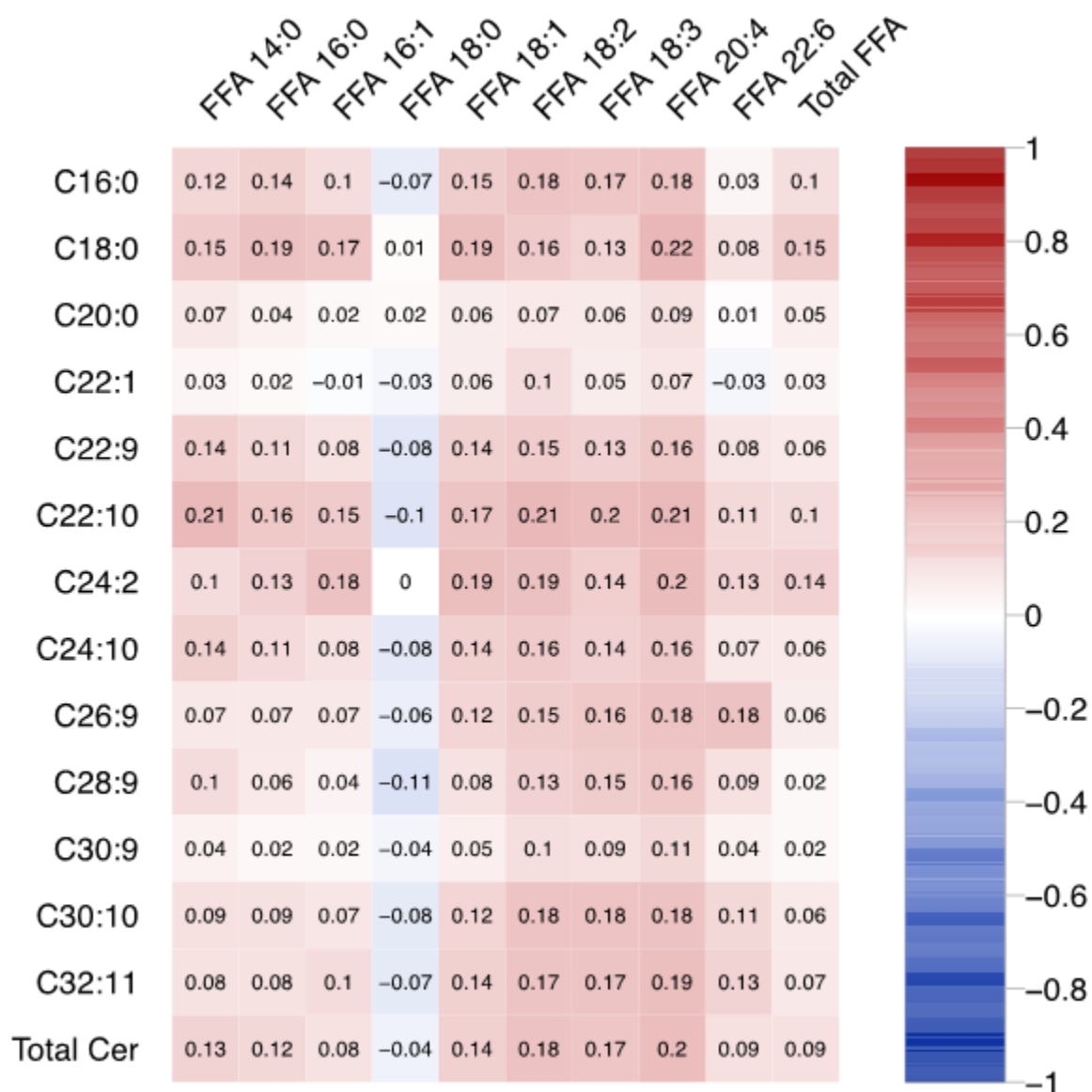| Outcome	Ceramide	N	N case	OR	95% CI	P-value
HOMA-IR > 3	C16:0	806	207	1.132	(0.935-1.371)	0.2039
HOMA-IR > 3	C18:0	829	216	1.120	(0.944-1.329)	0.1928
HOMA-IR > 3	C20:0	806	211	0.989	(0.853-1.147)	0.8812
HOMA-IR > 3	C22:1	821	220	1.113	(0.957-1.293)	0.1642
HOMA-IR > 3	C22:9	855	225	0.930	(0.796-1.088)	0.3643
HOMA-IR > 3	C22:10	855	225	0.913	(0.766-1.089)	0.3125
HOMA-IR > 3	C24:2	787	209	1.053	(0.901-1.232)	0.5162
HOMA-IR > 3	C24:10	855	225	0.946	(0.813-1.101)	0.4737
HOMA-IR > 3	C26:9	855	225	0.870	(0.701-1.081)	0.2088
HOMA-IR > 3	C28:9	855	225	1.097	(0.925-1.301)	0.2864
HOMA-IR > 3	C30:9	855	225	1.035	(0.887-1.207)	0.6655
HOMA-IR > 3	C30:10	855	225	1.042	(0.883-1.230)	0.6252
HOMA-IR > 3	C32:11	855	225	0.976	(0.824-1.156)	0.7783

P-values were calculated using logistic regression model adjusted for age, sex, ethnicity, VAT, BMI, and baseline HOMA-IR. OR = odds ratio for incident HOMA-IR>3 per 1-standard deviation of ceramide concentration. P<0.0003 considered statistically significant

ESM Fig. 1. Adjusted Correlations between Ceramide Species in the Dallas Heart Study

Adjusted for age, sex, ethnicity, and plate

ESM Fig. 2. Adjusted Correlations between Ceramide and Non-Esterified Free Fatty Acid Species in the Dallas Heart Study

	FFA 14:0	FFA 16:0	FFA 16:1	FFA 18:0	FFA 18:1	FFA 18:2	FFA 18:3	FFA 20:4	FFA 22:6	Total FFA
C16:0	0.12	0.14	0.1	−0.07	0.15	0.18	0.17	0.18	0.03	0.1
C18:0	0.15	0.19	0.17	0.01	0.19	0.16	0.13	0.22	0.08	0.15
C20:0	0.07	0.04	0.02	0.02	0.06	0.07	0.06	0.09	0.01	0.05
C22:1	0.03	0.02	−0.01	−0.03	0.06	0.1	0.05	0.07	−0.03	0.03
C22:9	0.14	0.11	0.08	−0.08	0.14	0.15	0.13	0.16	0.08	0.06
C22:10	0.21	0.16	0.15	−0.1	0.17	0.21	0.2	0.21	0.11	0.1
C24:2	0.1	0.13	0.18	0	0.19	0.19	0.14	0.2	0.13	0.14
C24:10	0.14	0.11	0.08	−0.08	0.14	0.16	0.14	0.16	0.07	0.06
C26:9	0.07	0.07	0.07	−0.06	0.12	0.15	0.16	0.18	0.18	0.06
C28:9	0.1	0.06	0.04	−0.11	0.08	0.13	0.15	0.16	0.09	0.02
C30:9	0.04	0.02	0.02	−0.04	0.05	0.1	0.09	0.11	0.04	0.02
C30:10	0.09	0.09	0.07	−0.08	0.12	0.18	0.18	0.18	0.11	0.06
C32:11	0.08	0.08	0.1	−0.07	0.14	0.17	0.17	0.19	0.13	0.07
Total Cer	0.13	0.12	0.08	−0.04	0.14	0.18	0.17	0.2	0.09	0.09

Adjusted for age, sex, ethnicity, and plate
FFA=free fatty acid