

Table S1. Cold intolerance in WT and *Gdm*^{-/-}.*Ucp1*^{-/-} mice

		Acute cold exposure	Cold acclimation
		% Cold-intolerant	% Cold-intolerant
WT	Male	0 (n=16)	0 (n=11)
	Female	0 (n=6)	0 (n=6)
<i>Gdm</i> ^{-/-} . <i>Ucp1</i> ^{-/-}	Male	94 (n=18)	10 (n=10)
	Female	92 (n=12)	20 (n=10)

Table S2. Gene expression in liver of cold-adapted WT and *Gdm*^{-/-}.*Ucp1*^{-/-} mice

Gene	Liver		Ratio (B/A)	P-value
	WT (n=5) (A)	<i>Gdm</i> ^{-/-} . <i>Ucp1</i> ^{-/-} (n=5) (B)		
Glucose metabolism				
Glut2	254±74	247±33	1.0	0.931
Pepck	286±149	117±26	0.4	0.345
Lipid metabolism				
Acox	79±12	56±3	0.7	0.144
Acs11	33±6	26±3	0.8	0.304
Acs12	29±4	24±3	0.8	0.295
Fasn	6±2	8±2	1.3	0.465
CptI	183±58	107±13	0.6	0.270
Scd1	6±1	5±2	0.8	0.606
Mitochondrial metabolism and transport				
Ant2	148±64	50±5	0.3	0.202
Slc25a25	152±42	111±12	0.7	0.409
mt-co2	30±4	29±1	0.9	0.936
Transcription factors and co-activators				
Pgc-1alpha	5±1	11±3	2.2	0.082
PPAR-alpha	85±9	73±4	0.8	0.282
PPAR-delta	24±11	24±5	1.0	0.985
Srebp1a	43±29	18±4	0.4	0.46
Srebp1c	26±2	31±9	1.2	0.626
Srebp2	52±9	66±5	1.3	0.241
Calcium cycling				
Serca2a	14±1	18±1	1.3	0.059

All values are mean ± SEM. P-value is the result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between cold-adapted *Gdm*^{-/-}.*Ucp1*^{-/-} and WT mice.

Table S3. Gene expression in gastrocnemius red muscle of cold-adapted WT and *Gdm*^{-/-}.*Ucp1*^{-/-} mice

Gene	WT (n=5) (A)	Gastrocnemius red <i>Gdm</i> ^{-/-} . <i>Ucp1</i> ^{-/-} (n=5) (B)	Ratio (B/A)	P-value
Glucose metabolism				
Glut4	668 ± 65	1056 ± 95	1.6	0.0116
Pdk4	389 ± 50	304 ± 105	0.8	0.503
Pepck	15 ± 2	35 ± 1	2.3	0.0004
Lipid metabolism				
Acox	103 ± 10	195 ± 52	1.9	0.160
Acs11	169 ± 24	194 ± 13	1.1	0.400
Acs12	205 ± 29	238 ± 16	1.1	0.369
Fasn	8.4 ± 0.9	18 ± 5	2.2	0.138
Hsl	7.4 ± 1.4	10 ± 2	1.4	0.283
Cpt1	584 ± 88	809 ± 131	1.4	0.195
Scd1	18 ± 1	31 ± 6	1.7	0.108
Mitochondrial metabolism and transport				
Ant1	858 ± 160	1158 ± 245	1.3	0.338
Ant2	238 ± 90	281 ± 51	1.2	0.685
Slc25a25	171 ± 14	312 ± 42	1.8	0.0236
mt-co2	451 ± 57	705 ± 121	1.6	0.105
Ion transport				
Slc20a2	264 ± 17	335 ± 28	1.2	0.067
Transcription factors and co-activators				
Pgc-1alpha	314 ± 31	862 ± 197	2.7	0.051
PPAR-alpha	143 ± 10	420 ± 97	2.9	0.047
PPAR-delta	56 ± 4	93 ± 8	1.7	0.008
PPAR-gamma2	25 ± 2	35 ± 5	1.4	0.158
Srebp1a	698 ± 431	590 ± 457	0.8	0.869
Srebp1c	86 ± 14	72 ± 18	0.8	0.548
Srebp2	193 ± 38	194 ± 26	1.0	0.990
Thermogenesis				
Dio2	43 ± 5	34 ± 7	0.7	0.286
Calcium cycling				
Serca1a	602 ± 60	667 ± 105	1.1	0.612
Serca2a	790 ± 123	775 ± 45	1.0	0.916

All values are mean ± SEM. P-value is result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between cold-adapted *Gdm*^{-/-}.*Ucp1*^{-/-} and WT mice.

Table S4. Gene expression in gastrocnemius white muscle of cold-adapted WT and *Gdm^{-/-}.Ucp1^{-/-}* mice

Gene	Gastrocnemius white		Ratio (B/A)	P-value
	WT (n=5) (A)	<i>Gdm^{-/-}.Ucp1^{-/-}</i> (n=5) (B)		
Glucose metabolism				
Glut4	1437 ± 810	2005 ± 1056	1.4	0.014
Pdk4	353 ± 16	663 ± 261	1.8	0.300
Pepck	10 ± 3	109 ± 10	10.4	0.119
Lipid metabolism				
Acox	78 ± 7	143 ± 17	1.9	0.012
Acs11	94 ± 7	167 ± 24	1.8	0.030
Acs12	116 ± 6	187 ± 23	1.6	0.027
Fasn	12 ± 3	40 ± 14	3.4	0.114
Hsl	10 ± 3	20 ± 6	1.9	0.249
Cpt1	459 ± 28	559 ± 92	1.2	0.345
Scd1	40 ± 12	65 ± 21	1.6	0.339
Mitochondrial metabolism and transport				
Ant1	650 ± 140	972 ± 159	1.5	0.166
Ant2	169 ± 83	505 ± 124	3.0	0.074
Slc25a25	243 ± 29	901 ± 95	3.7	0.002
mt-co2	295 ± 41	417 ± 39	1.4	0.0637
Ion transport				
Slc20a2	176 ± 9	262 ± 22	1.4	0.014
Transcription factors and co-activators				
Pgc-1alpha	227 ± 16	758 ± 128	3.3	0.025
PPAR-alpha	60 ± 3	185 ± 24	3.1	0.006
PPAR-delta	69 ± 9	121 ± 23	1.8	0.089
PPAR-gamma2	60 ± 16	83 ± 20	1.4	0.382
Srebp1a	466 ± 246	501 ± 265	1.1	0.925
Srebp1c	85 ± 8	99 ± 27	1.2	0.651
Srebp2	200 ± 31	198 ± 27	0.9	0.954
Thermogenesis				
Dio2	22 ± 2	16 ± 1.1	0.7	0.048
Calcium cycling				
Serca1a	1018 ± 197	1355 ± 292	1.3	0.370
Serca2a	98 ± 10	123 ± 21	1.2	0.339

All values are mean ± SEM. P-value is result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between cold-adapted *Gdm^{-/-}.Ucp1^{-/-}* and WT mice.

Table S5. Gene expression in inguinal fat of cold-adapted WT and *Gdm*^{-/-}.*Ucp1*^{-/-} mice

Gene	Inguinal Fat			P-value
	WT (n=5) (A)	<i>Gdm</i> ^{-/-} . <i>Ucp1</i> ^{-/-} (n=5) (B)	Ratio (B/A)	
Glucose metabolism				
Glut4	88 ± 8	205 ± 24	2.3	0.009
Pdk4	25 ± 7	168 ± 23	6.7	0.0017
Pepck	419 ± 62	506 ± 192	1.2	0.689
Lipid metabolism				
Acox	83 ± 5	100 ± 12	1.2	0.227
Acs11	256 ± 44	257 ± 39	1.0	0.987
Acs12	266 ± 46	249 ± 45	0.9	0.796
Fasn	356 ± 59	677 ± 123	1.9	0.056
Hsl	741 ± 188	754 ± 122	1.0	0.956
Cpt1	40 ± 12	256 ± 33	6.4	0.00158
Scd1	423 ± 69	545 ± 97	1.3	0.34
Mitochondrial metabolism and transport				
Ant1	13 ± 2	16 ± 2	1.3	0.293
Ant2	183 ± 27	433 ± 190	2.4	0.241
Slc25a25	77 ± 23	31 ± 15	0.4	0.155
mt-co2	63 ± 5	81 ± 15	1.3	0.285
Ion transport				
Slc20a2	27 ± 2	45 ± 7	1.7	0.046
Transcription factors and co-activators				
Pgc-1alpha	45 ± 5	82 ± 12	1.8	0.037
PPAR-alpha	46 ± 9	148 ± 17	3.2	0.0016
PPAR-delta	132 ± 34	166 ± 25	1.3	0.438
PPAR-gamma2	606 ± 59	282 ± 58	0.5	0.0044
Srebp1a	228 ± 106	263 ± 123	1.1	0.837
Srebp1c	468 ± 21	336 ± 70	0.7	0.143
Srebp2	140 ± 5	80 ± 9	0.5	0.00152
Thermogenesis				
Dio2	74 ± 10	468 ± 114	6.3	0.025
Calcium cycling				
Serca2a	36 ± 2	48 ± 5	1.3	0.101

All values are mean ± SEM. P-value is the result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between cold-adapted *Gdm*^{-/-}.*Ucp1*^{-/-} and WT mice.

Table S6. Gene expression in liver of WT and *Gdm*^{-/-}.*Ucp1*^{-/-} mice fed a high fat diet and kept at 20°C for 10 weeks and at 28 °C for another 10 weeks

Gene	Liver			P-value
	WT (n=5) (A)	<i>Gdm</i> ^{-/-} . <i>Ucp1</i> ^{-/-} (n=5) (B)	Ratio (B/A)	
Glucose metabolism				
G6Pase	178 ± 52	288 ± 36	1.6	0.123
Glut2	236 ± 27	189 ± 19	0.8	0.203
Pdk4	2.1 ± 0.3	1.1 ± 0.1	0.5	0.041
Pepck	88 ± 43	223 ± 59	2.5	0.108
Lipid metabolism				
Acox	124 ± 8	92 ± 12	0.74	0.082
Acs11	41 ± 8	46 ± 5	1.1	0.626
Acs12	43 ± 4	57 ± 5	1.3	0.053
CptI	540 ± 209	149 ± 23	0.3	0.159
Fasn	26 ± 7	16 ± 5	0.6	0.288
Hsl	2 ± 0.2	5 ± 1	1.9	0.182
Scd1	31 ± 2	13 ± 2	0.4	0.00038
Mitochondrial metabolism and transport				
Ant2	241 ± 49	155 ± 54	0.6	0.273
mt-co2	46 ± 12	33 ± 4	0.7	0.352
Slc25a25	94 ± 19	75 ± 5	0.8	0.366
Transcription factors and co-activators				
Pgc-1alpha	14 ± 1	14 ± 4	1.0	0.933
PPAR-alpha	169 ± 8	221 ± 26	1.3	0.161
PPAR-delta	30 ± 15	13 ± 2	0.4	0.322
PPAR-gamma2	18 ± 6	6 ± 4	0.3	0.069
Srebp1a	52 ± 6	39 ± 4	0.75	0.107
Srebp1c	76 ± 14	91 ± 13	1.2	0.443
Calcium cycling				
Serca2a	18 ± 4	10 ± 1	0.6	0.165

All values are mean ± SEM. P-value is result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between *Gdm*^{-/-}.*Ucp1*^{-/-} and WT mice fed a high fat diet.

Table S7. Gene expression in gastrocnemius red muscle of WT and *Gdm^{-/-}.Ucp1^{-/-}* mice fed a high fat diet and kept at 20°C for 10 weeks and at 28 °C for another 10 weeks

Gene	Gastrocnemius red			P-value
	WT (n=5) (A)	<i>Gdm^{-/-}.Ucp1^{-/-}</i> (n=5) (B)	Ratio (B/A)	
Glucose metabolism				
Glut4	735±77	737±37	1.0	0.984
Pdk4	1225±179	1595±360	1.3	0.392
Pepck	88±36	68±47	0.8	0.74
Lipid metabolism				
Acox	86±6	79±6	0.9	0.463
Acs11	237±51	226±22	0.9	0.846
Acs12	255±52	229±23	0.9	0.665
Fasn	9±2	14±4	1.5	0.365
Hsl	88±26	55±6	0.6	0.291
Cpt1	1005±210	772±53	0.7	0.493
Scd1	16±4	11±2	0.7	0.333
Mitochondrial metabolism and transport				
Ant1	2495±830	1741±656	0.7	0.496
Ant2	277±50	197±47	0.7	0.279
Slc25a25	228±40	161±42	0.7	0.279
mt-co2	735±181	539±47	0.7	0.342
Ion transport				
Slc20a2	248±12	238±14	0.9	0.605
Transcription factors and co-activators				
Pgc-1alpha	841±67	970±306	1.2	0.702
PPAR-alpha	396±110	428±172	1.1	0.879
PPAR-delta	450±9.5	495±38	1.1	0.295
PPAR-gamma2	14±2.4	17±3	1.3	0.399
Sreb1a	226±28	192±13	0.8	0.307
Sreb1c	121±12	129±14	1.1	0.647
Thermogenesis				
Dio2	287±17	231±17*	0.8	0.046
Calcium cycling				
Serca1a	757±64	887±64	1.2	0.190
Serca2a	1121±125	1164±273	1.0	0.89

All values are mean ± SEM. P-value is result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between *Gdm^{-/-}.Ucp1^{-/-}* and WT mice fed a high fat diet.

Table S8. Gene expression in gastrocnemius white muscle of WT and *Gdm*^{-/-}.*Ucp1*^{-/-} mice fed a high fat diet and kept at 20°C for 10 weeks and at 28 °C for another 10 weeks

Gene	Gastrocnemius white			P-value
	WT (n=5) (A)	<i>Gdm</i> ^{-/-} . <i>Ucp1</i> ^{-/-} (n=5) (B)	Ratio (B/A)	
Glucose metabolism				
Glut4	720±140	775±111	1.1	0.766
Pdk4	279±69	551±71	1.9	0.025
Pepck	68±28	244±84	3.6	0.104
Lipid metabolism				
Acox	41±4	53±7	1.3	0.213
Acs11	71±16	70±17	1.0	0.958
Acs12	91±15	93±16	1.0	0.906
Fasn	13±2	26±7	2.0	0.149
Hsl	90±31	108±28	1.2	0.662
Cpt1	417±91	383±87	0.9	0.794
Scd1	42±27	40±10	0.9	0.931
Mitochondrial metabolism and transport				
Ant1	854±194	1414±301	1.7	0.161
Ant2	138±14	191±27	1.4	0.127
Slc25a25	244±49	276±79	1.1	0.734
mt-co2	351±85	338±65	0.9	0.908
Ion transport				
Slc20a2	98±6	100±8	1.0	0.805
Transcription factors and co-activators				
Pgc-1alpha	368±17	396±61	1.1	0.677
PPAR-alpha	65±17	97±29	1.5	0.383
PPAR-delta	457±45	476±45	1.0	0.772
PPAR-gamma2	26±7	49±11	1.9	0.118
Sreb1a	281±27	262±24	0.9	0.613
Sreb1c	206±26	241±40	1.2	0.487
Thermogenesis				
Dio2	94±15	124±14	1.3	0.173
Calcium cycling				
Serca1a	1002±29	919±153	0.9	0.623
Serca2a	66±10	102±21	1.5	0.179

All values are mean ± SEM. P-value is result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between *Gdm*^{-/-}.*Ucp1*^{-/-} and WT mice fed a high fat diet.

Table S9. Gene expression in inguinal fat of WT and *Gdm^{-/-}.Ucp1^{-/-}* mice fed a high fat diet and kept at 20°C for 10 weeks and at 28 °C for another 10 weeks

Gene	Inguinal fat			P-value
	WT (n=5) (A)	<i>Gdm^{-/-}.Ucp1^{-/-}</i> (n=5) (B)	Ratio (B/A)	
Glucose metabolism				
Glut4	40±4.7	108±16	2.7	0.028
Pdk4	11±1	75±27	6.7	0.097
Pepck	118±39	4352±1960	36.8	0.097
Lipid metabolism				
Acox	72±7	126±12	1.7	0.012
Acs11	204±24	241±39	1.2	0.445
Acs12	197±25	313±42	1.6	0.049
Fasn	220±25	355±51	1.6	0.075
Hsl	229±23	479±19	2.1	0.00003
Cpt1	10.3±1.1	95±22	9.3	0.018
Scd1	299±61	615±29	2.1	0.0034
Mitochondrial metabolism and transport				
Ant1	14±2	53±16	3.9	0.092
Ant2	167±29	323±61	1.9	0.082
Slc25a25	122±7	343±55	2.8	0.028
mt-co2	45±6.7	117±16	2.6	0.008
Ion transport				
Slc20a2	18±1	40±5	2.3	0.0095
Transcription factors and co-activators				
Pgc-1alpha	17±2	237±58	14	0.032
PPAR-alpha	14±2	151±41	10.8	0.044
PPAR-delta	131±12	234±16	1.8	0.0024
PPAR-gamma2	317±30	805±91	2.5	0.007
Srebp1a	132±9	202±23	1.5	0.038
Srebp1c	139±9	317±46	2.3	0.0197
Srebp2	107±10	174±37	1.6	0.173
Thermogenesis				
Dio2	9±2	277±8	30.3	0.045
Calcium cycling				
Serca2a	37±3	64±7	1.7	0.024

All values are mean ± SEM. P-value is result of statistical analysis using Student's t-Test. B/A represents fold-change in gene expression between *Gdm^{-/-}.Ucp1^{-/-}* and WT mice fed a high fat diet.

Table S10. Blood and tissue metabolites in WT and *Gdm*^{-/-}.*Ucp*^{-/-} mice fed chow and adapted to 4°C, and in WT and *Gdm*^{-/-}.*Ucp*^{-/-} mice fed a high fat diet and reared at 20°C for 10 weeks, then at 28°C for 10 weeks

	WT	<i>Gdm</i> ^{-/-} . <i>Ucp</i> ^{-/-}	P-value
Chow, 4°C			
Serum L-lactic acid (mg/dl)	25.9 ± 1.3 (6)	29.7 ± 4.1 (5)	0.378
Serum triglyceride (mg/dl)	71.7 ± 11.2 (6)	56.2 ± 4.8 (5)	0.204
Serum ketone (mg/dl)	5.2 ± 0.2 (6)	6.0 ± 0.4 (5)	0.065
Blood glucose (mg/dl)	111 ± 3 (6)	104 ± 3 (5)	0.132
Serum T3 (ng/dl)	70 ± 12 (6)	92 ± 3 (8)	0.133
Serum T4 (µg/dl)	8.1 ± 0.3 (6)	8.4 ± 0.3 (8)	0.532
High fat diet, 20°C and 28°C			
Fasting blood glucose (mg/dl)	143 ± 9 (7)	123 ± 10 (7)	0.070
Serum T3(ng/dl)	81 ± 5 (5)	88 ± 3 (5)	0.310
Serum T4 (ug/dl)	7.7 ± 0.7 (5)	8.4 ± 0.2 (5)	0.417
Liver triglycerides (mg/g tissue)	110 ± 13 (6)	81 ± 8 (6)	0.040
Skeletal muscle (mg/g tissue)	170 ± 18 (6)	129 ± 11 (6)	0.052

All values are mean ± SEM. Values in parenthesis correspond to number of animals examined. P-value is the result of statistical analysis using Student's t-test.