Supplemental Table S1. Primer sequences of the selected gene.
The sequences of primers of indicated genes for detection by q-PCR are shown.

	5’	3’	Accession number
Ucp1	GGCCTCTACGACTCAGTCCA	TAAGCCGGCTGAGATCTTGT	NM_009463
Pparα	CCTTCCCTGTGAACTGACG	CCACAGAGCGCTAAGCTGT	NM_011144
Pparγ	GAAAGACAACGGACAAATCACC	GGGGGTGATATGTTTGAACTTG	NM_011146
Pdk4	CGCTTAGTGAACACTCCTTCG	CTTCTGGGCTCTTCTCATGG	NM_013743
Fabp3	CTTTGTCCGGTACCTGGAAGC	TGGTCATGCTAGCCACCTG	NM_010174
Elovl3	ACTTCGAGACGTTTCAGGACTTA	GACGACCACTATGAGAAATGAGC	NM_007703
Elovl6	CAGCAAAGCACCCGAACTA	AGGAGCACAGTGATGTGGTG	NM_130450
Cpt1b	GAGTGACTGGTGGGAAGAATATG	GCTGCTTGCACATTTGTGTT	NM_009948
Cox7a1	CGAAGAGGGGAGGTGACTC	AGCCTGGGAGACCCGTAG	NM_009944
Cox8b	CCAGCCAAAACTCCCACTT	GAACCATGAAGCCAACGAC	NM_007751
Cidea	GTCTGCAAGCAACCAAAGAA	ATTGAGACAGCCGAGGAAGT	NM_007702
36B4	GATGCCCAGGGAAGACAG	ACAATGAAGCATTTTGGATAATCA	NM_007475

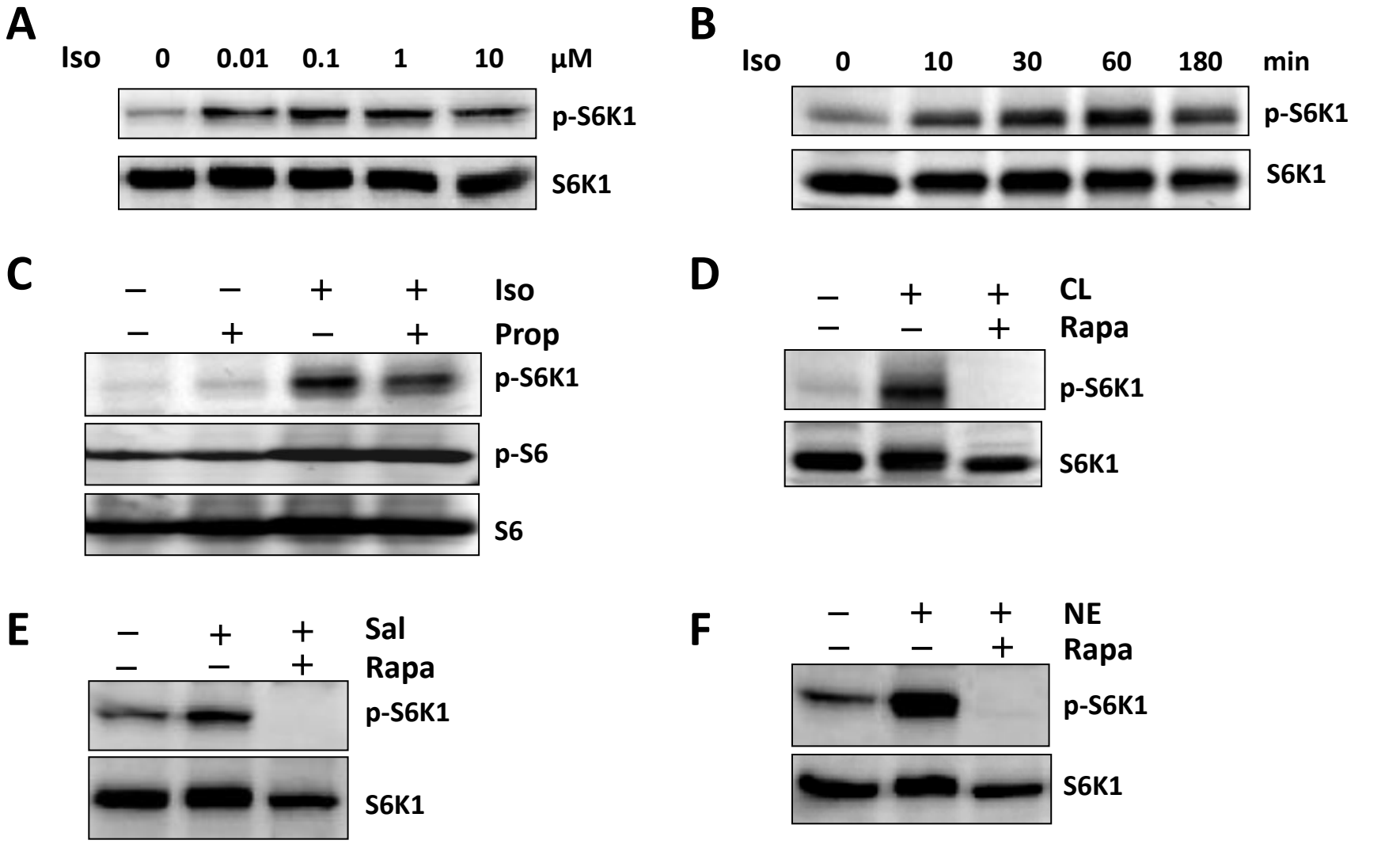


Fig S1. All three βAR subtypes in adipocytes activate mTOR-S6K1 signaling.
(A) 3T3-L1 adipocytes were treated with the indicated concentrations of isoproterenol (Iso) for 1 hr or **(B)** the indicated times with 1 μM Iso, followed by immunoblotting of lysates for phospho-S6K1 and total S6K1. **(C)** Iso (1 μM) was added in the presence or absence of propranolol (Prop, 0.5 μM), and lysates were assayed for phosphorylated S6K1 and S6. 3T3-L1 adipocytes were treated with the following regimens and lysates were assayed for S6K1 phosphorylation: **(D)** β_3AR-selective agonist CL316,243 (5 μM) pretreated or not with rapamycin (Rapa, 100 nM); **(E)** β_2AR-selective agonist salbutamol (Sal, 5 μM) pretreated or not with rapamycin (Rapa, 100 nM); **(F)** norepinephrine (NE, 1 μM) in the presence or absence of Rapa (100 nM).

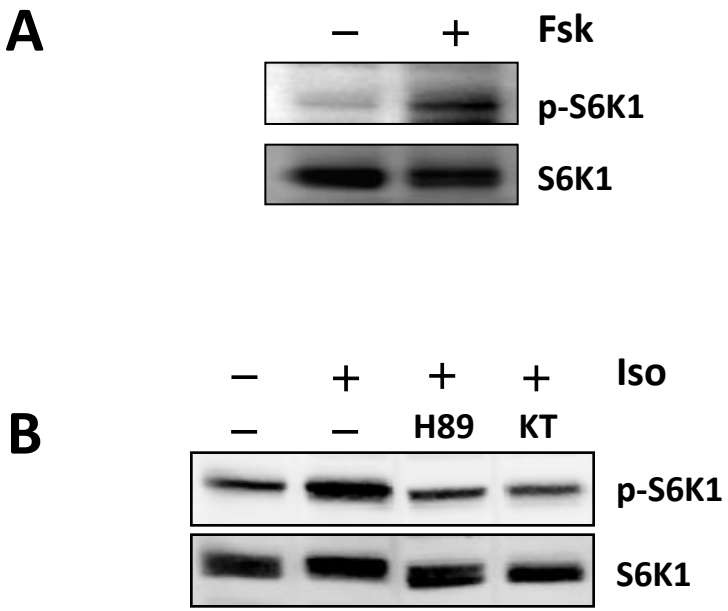


Fig S2. PKA mediates S6K1 phosphorylation.
(A) 3T3-L1 adipocytes were treated or not with the adenylyl cyclase activator forskolin (Fsk,10 μM) for 1 hr, followed by measurement of phospho- and total S6K1. **(B)** 3T3-L1 adipocytes were treated with the PKA inhibitor H89 (20 μM) or KT 5720 (KT, 10 μM) for 30 min as indicated. Following the addition of Iso for 1 hr, cells were lysed and processed for Western blotting to measure phosphorylation of S6K1 or total S6K1.

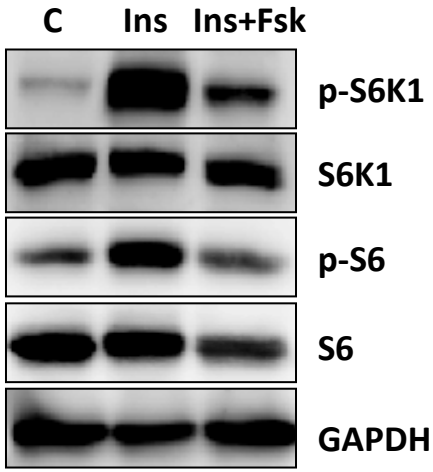


Fig S3. Fsk suppresses insulin mediated mTORC1 action in 3T3-L1 adipocytes

3T3-L1 adipocytes were maintained in DMEM without FBS overnight, treated with Ins (10 nM) alone or Fsk (20 μM) 30 min prior to 30 min Ins (10 nM) treatment. Phosphorylated S6K1 and S6 and their respective total proteins were measured by Western blotting. GAPDH served as loading control.

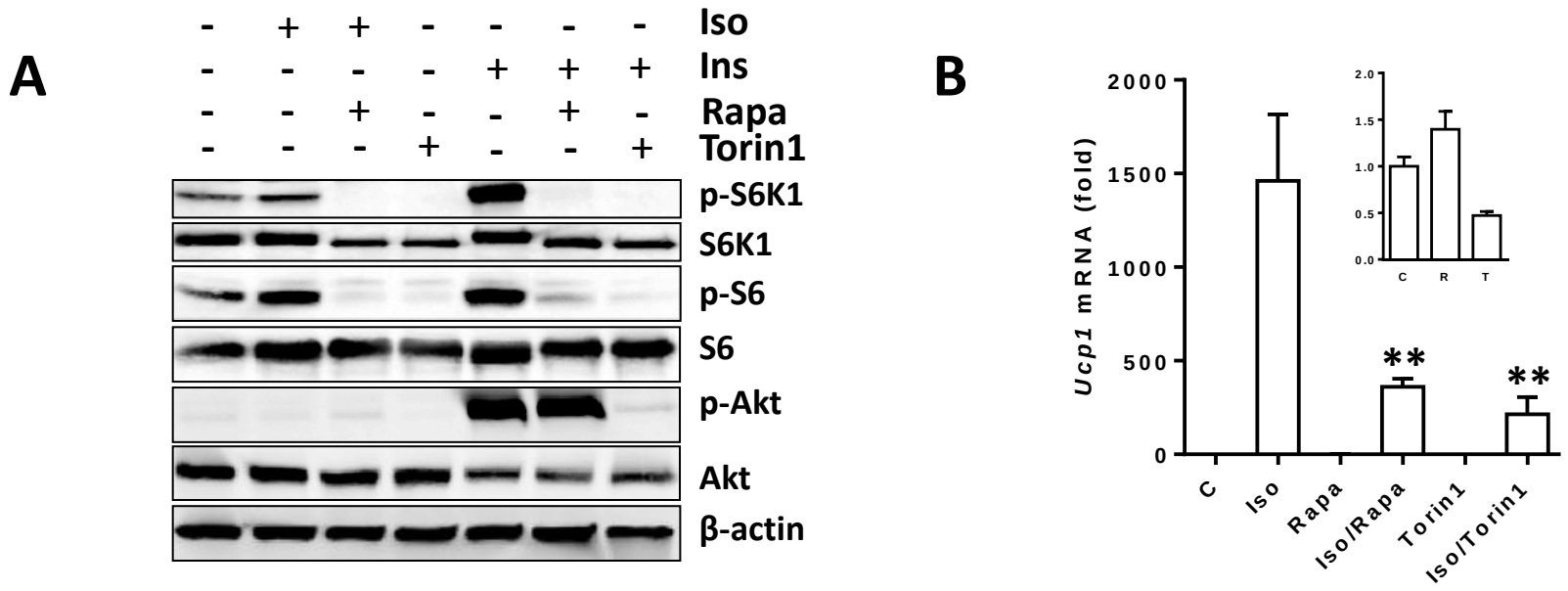


Fig S4. Both rapamycin and torin1 block βAR activation in HIB-1B cells.
HIB-1B adipocytes were pre-treated with Rapa (100 nM) or torin1 (250 nM), **(A)** followed by Iso (1 μM) or insulin (Ins, 10 nM) for 30 min for cell lysate processed for Western blotting to detect p-S6K1, p-S6, p-Akt (S473), and respective total proteins and β-actin as loading control. **(B)** followed by Iso (100 nM) treatment for 6 hours. qPCR was performed to detect UCP1 gene expression level normalized by internal control 36B4. Compared with Iso treatment group, **: $p<0.01$. The inset bar graph shows an expanded scale for the following groups: C (untreated control); R (Rapa alone); T (Torin1 alone).

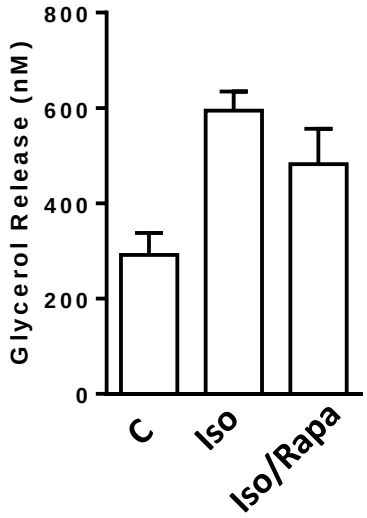


Fig S5. mTORC1 inhibition does not affect Iso-mediated lipolysis.
3T3-L1 adipocytes were pretreated with Rapa (100nM) for 30 minutes, followed by treatment of Iso (1 μM) for 1 hr, medium glycerol was measured by Sigma Aldrich free glycerol reagent (F-6428) according to protocol.

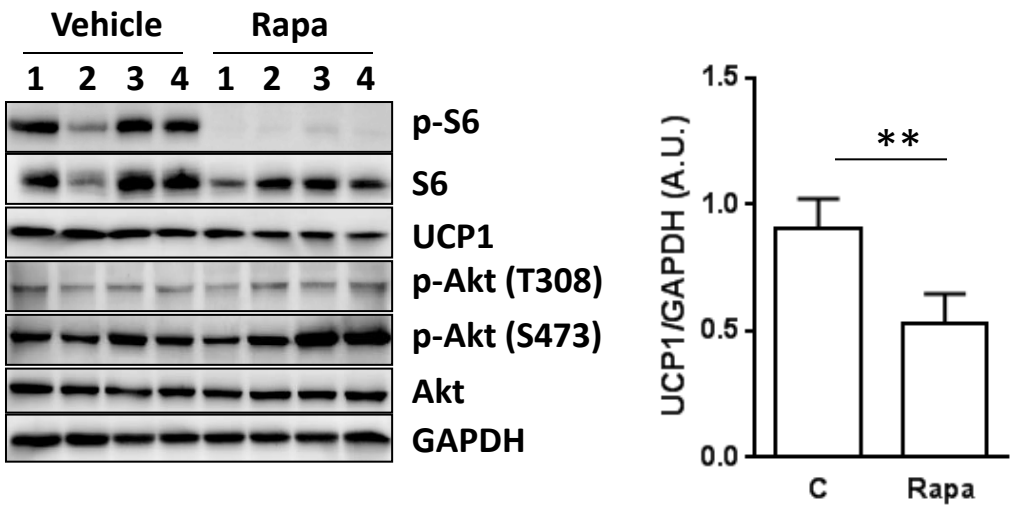
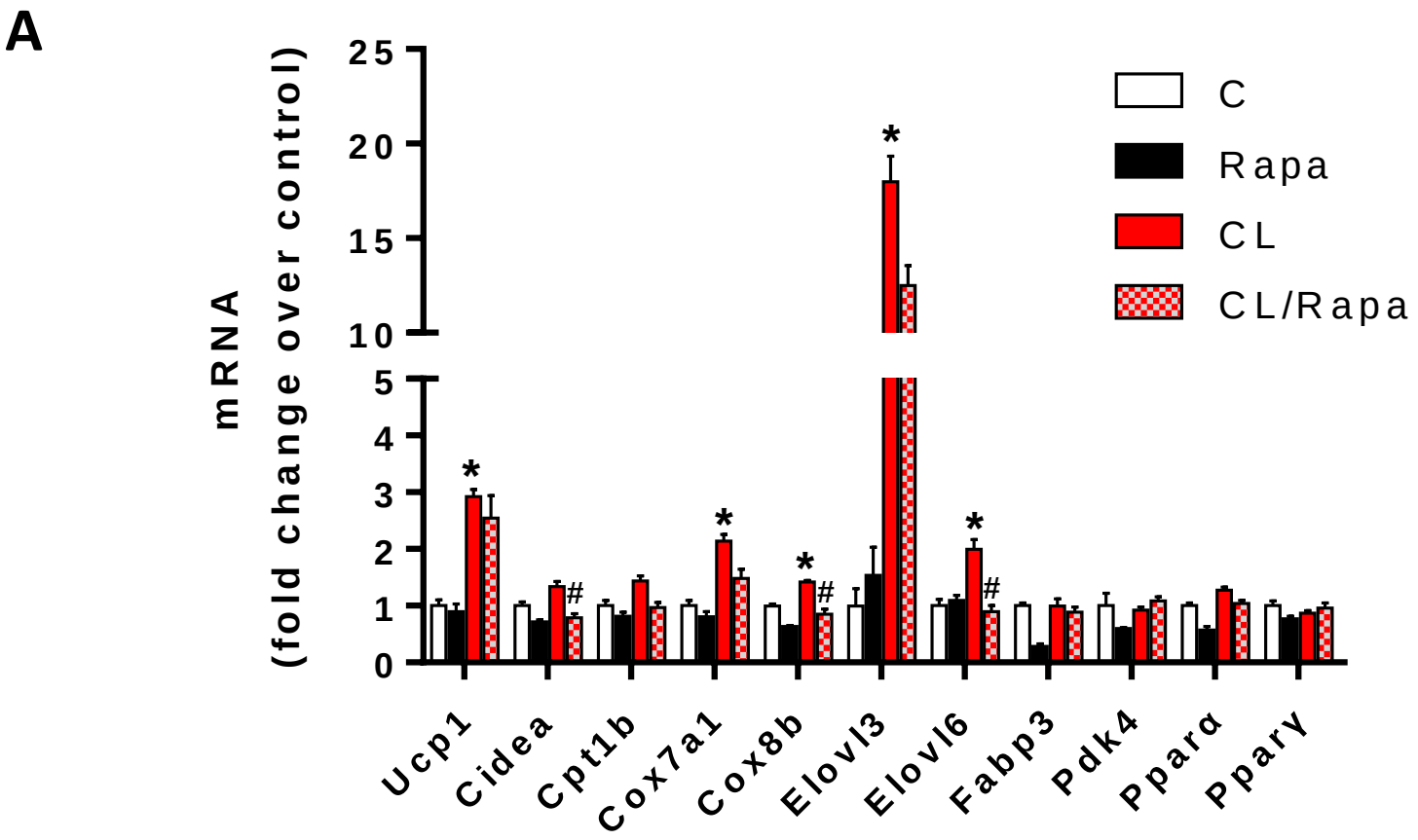


Fig S6. Rapamycin modestly suppresses UCP1 in iBAT after acute 10 hour cold exposure.

Rapamycin (4mg/kg bw) was intraperitoneally administered one day before cold exposure. Mouse was singly caged with free access to water gel, placed in cold room (4°C) for up to 10 hrs. The lysates from iBAT of vehicle (n=4) or rapamycin (n=4) groups were analysed with immunoblotting for phospho- and total S6, UCP1, phospho-Akt (T308 and S473) and total Akt, and internal control GAPDH. Band quantification of UCP1 to GAPDH was shown in the right panel. **: $p<0.01$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mRNA
(fold change over control)
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C
Rapa
CL
CL/Rapa
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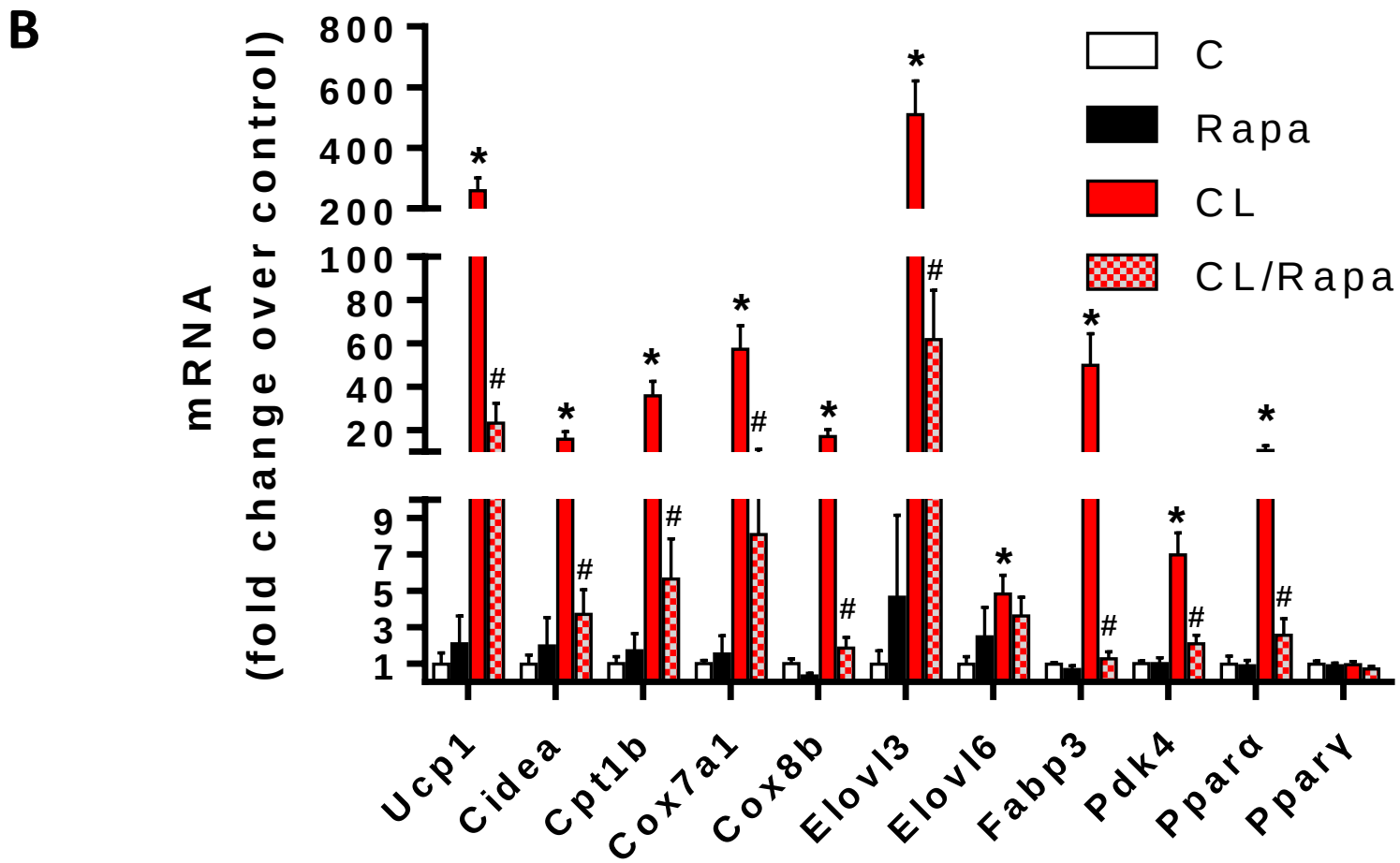
Ucp1
Cidea
Cpt1b
Cox7a1
Cox8b
Elovl3
Elovl6
Fabp3
Pdk4
Ppara
Pparγ

Fig S7.


B
mRNA
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800
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Rapa
CL
CL/Rapa
Ucp1
Cidea
Cpt1b
Cox7a1
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Elovl3
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Fabp3
Pdk4
Ppara
Pparγ

Fig S7.

C

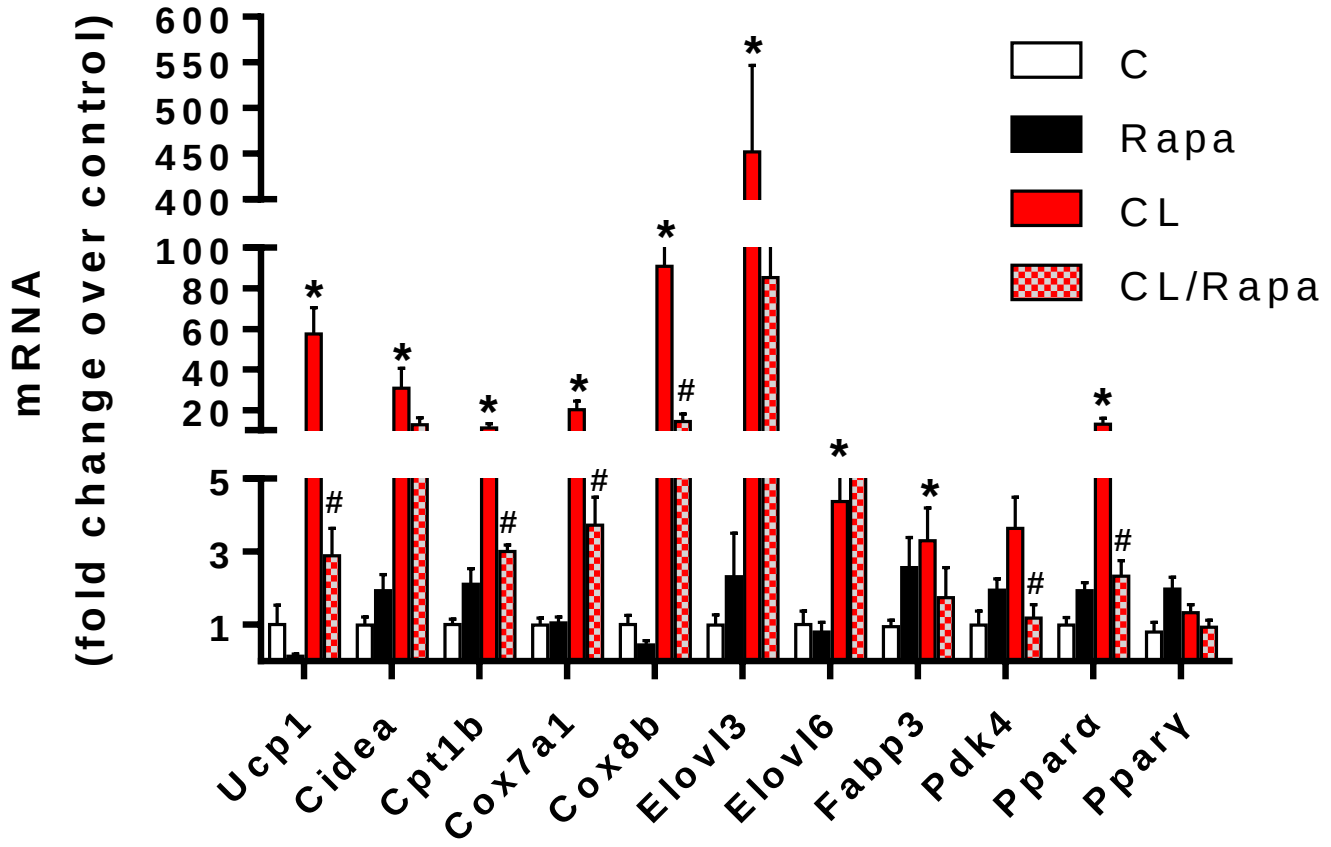

Fig S7. mTORC1 inhibition blocks gene expressions of adipose browning

Gene expressions of browning markers in **(A)** iBAT, **(B)** iWAT, and **(C)** gWAT after 1 week of β3AR agonist CL and/or Rapamycin treatment (as described in **Fig4**). The gene transcripts include Ucp1, Cidea, Cpt1b, Cox7a1, Cox8b, Elovl3, Elovl6, Fabp3, Pdk4, and nuclear receptors Pparα and Pparγ. The relative gene expression was normalized to internal control 36B4 and each gene expression was presented finally as fold change over vehicle control. C vs CL, *:$p<0.05$; CL vs CL/Rapa, #: $p<0.05$.

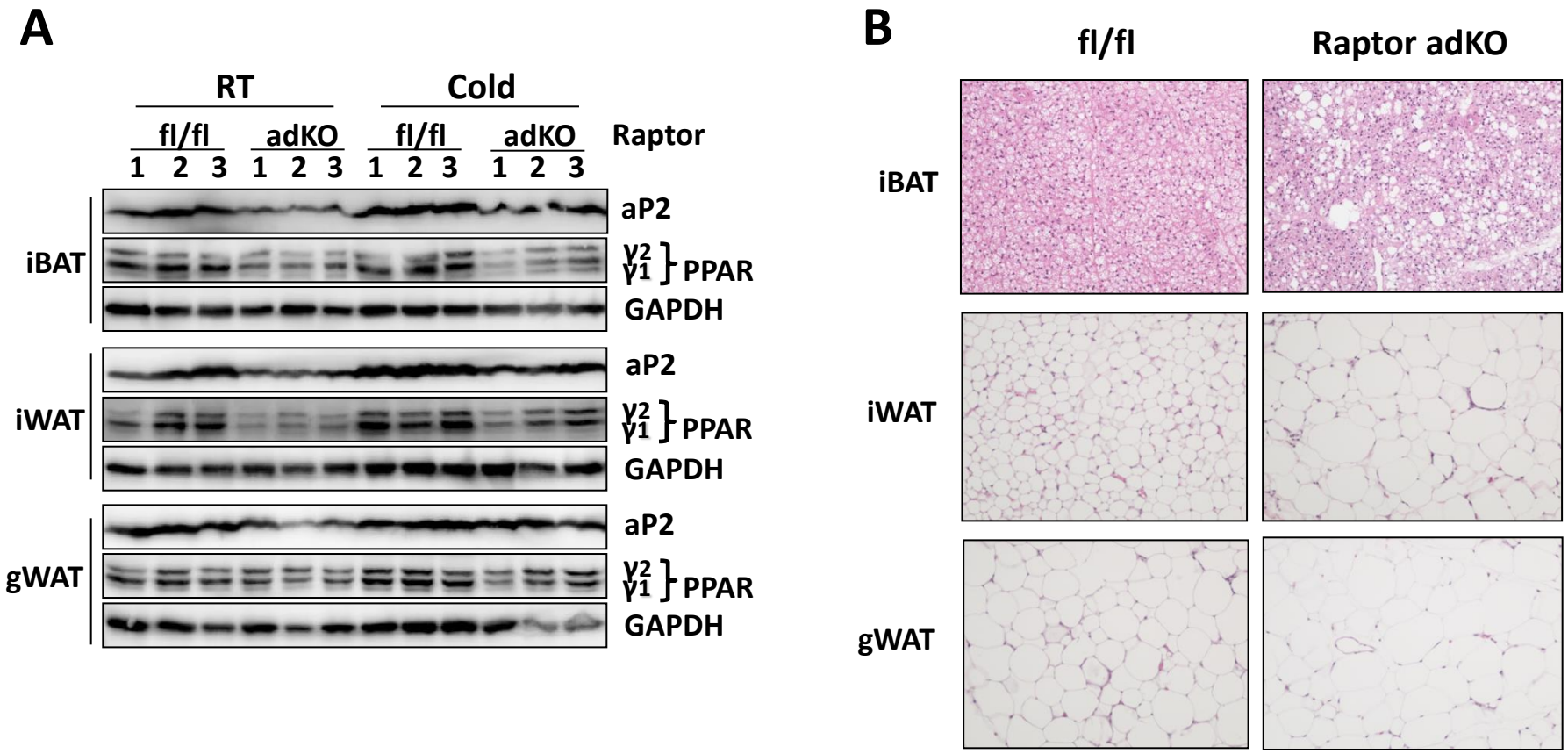

Fig S8. Adipogenic markers and adipose histology of Raptor fl/fl and adKO mice.

(A) The adipogenic markers aP2 and PPARγ in iBAT, iWAT, and gWAT were measured by Western blotting with respective antibodies from Cell Signaling Technologies in Raptor fl/fl and adipose knockout (KO) mice. GAPDH served as loading control. **(B)** H&E staining of iBAT, iWAT, and gWAT: 20X magnification.