**Supplemental Information**

# Preadipocyte IL-13-IL-13Rα1 signaling regulates beige adipogenesis through modulation of PPARγ activity

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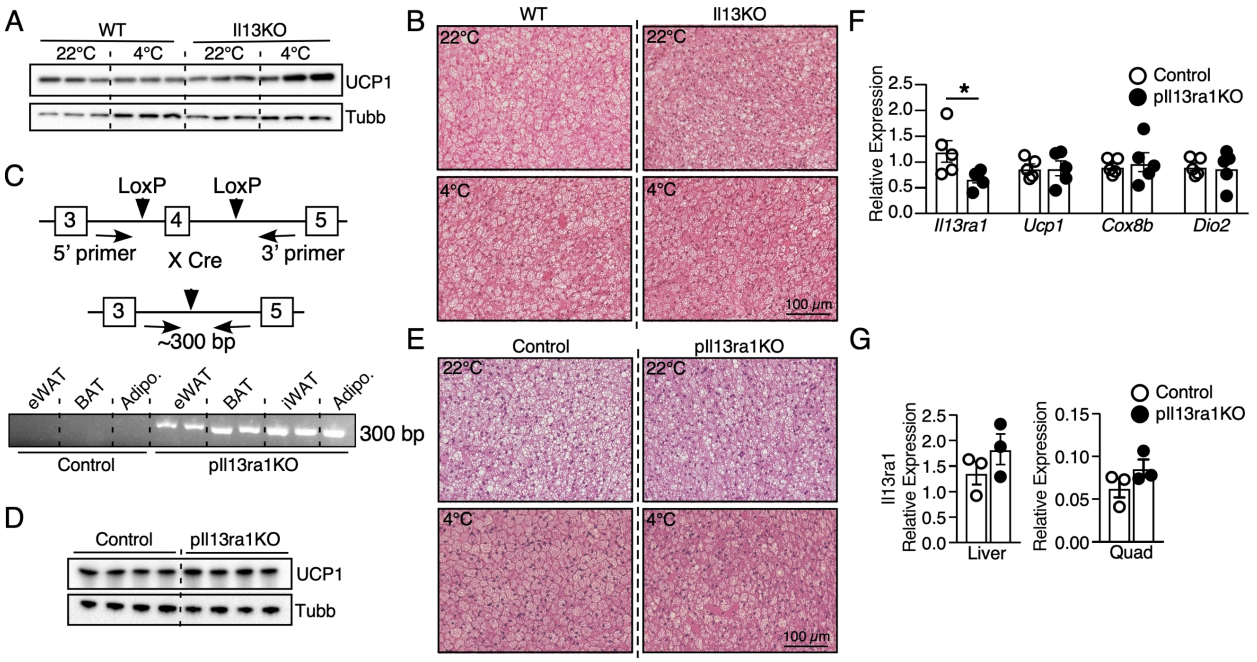
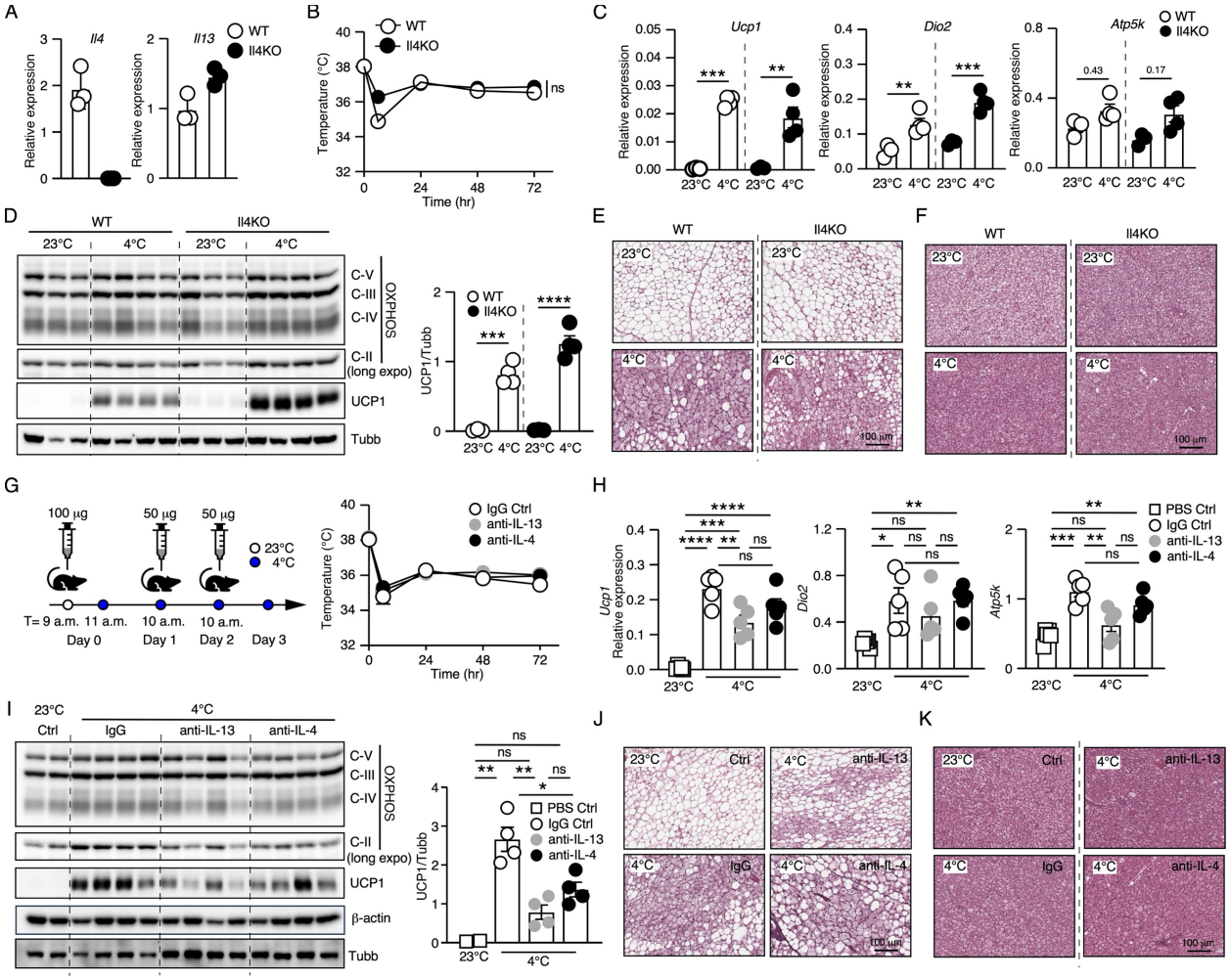
## Supplemental Figures

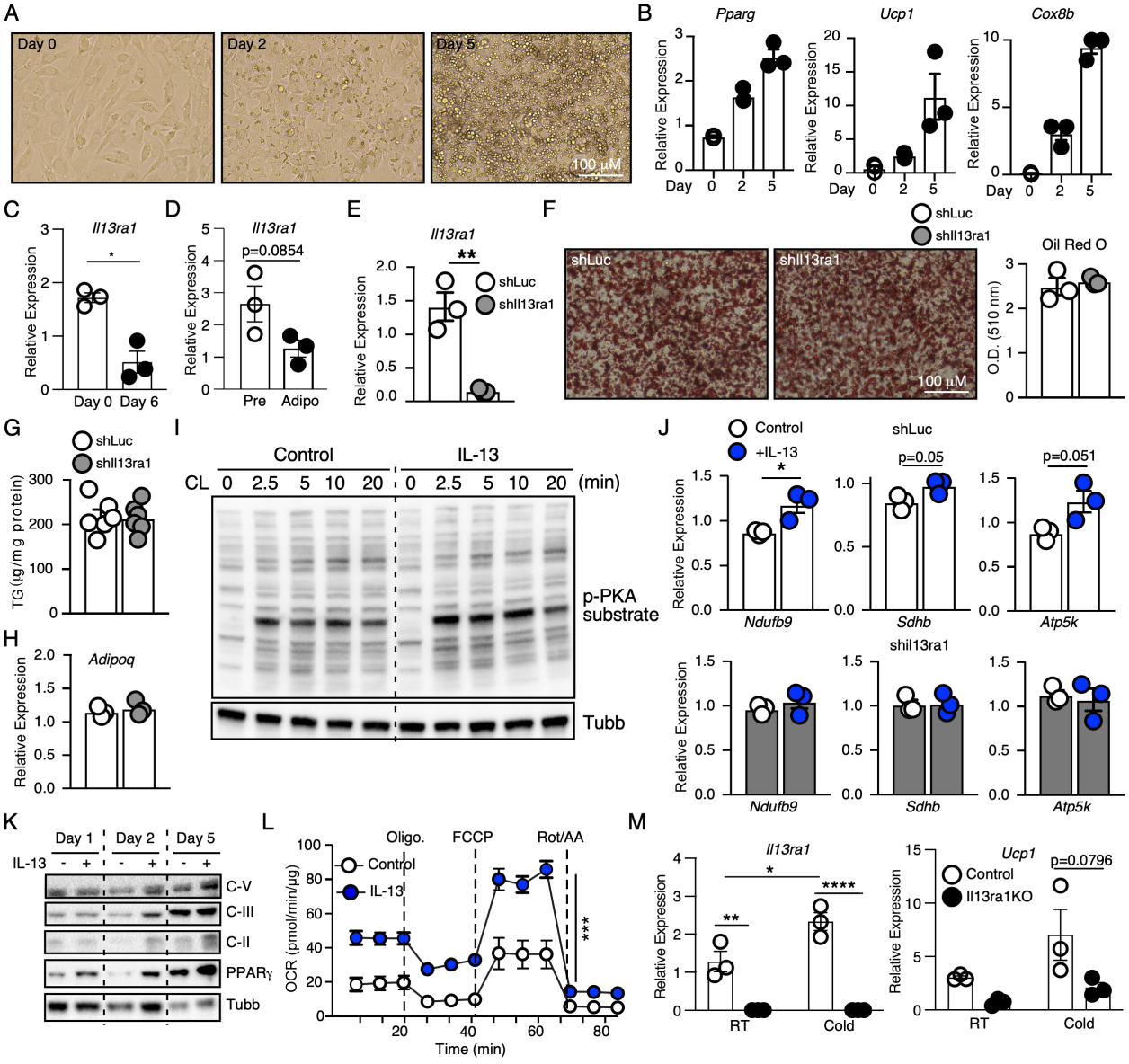



**Supplemental Figure 1. IL-13 /IL-13Rα1 signaling does not regulate cold-induced brown adipocyte recruitment.** (**A**) Immunoblots showing UCP1 protein in BAT of WT and Il13KO mice housed at 4°C or 22°C for 72 hours. n=5-6 per group, 8-week-old female mice, experiment performed once. Representative tissue samples from 3 mice/group are shown. Tubb: tubulin as a loading control. (**B**) Representative H&E staining images of BAT from mice in (A). (**C**) Schematic of *Il13ra1* deletion site and detection of genomic DNA for the 300 base-pair excised fragment of *Il13ra1* in the adipose depots of control and pIl13ra1KO mice. n=2 mice/group, 5-6-month-old male control mice; 7-week-old male pIl13ra1KO mice, experiment performed once. (**D**) Immunoblotting of UCP1 protein, (**E**) Representative H&E staining images and (**F**) Expression of *Il13ra1* and thermogenic genes measured by RT-qPCR in BAT of control and pIl13ra1KO mice after a 72-hour cold tolerance test at 4°C. n=5/group, 5-7-week-old male mice, experiment performed once. Age-matched room-temperature controls were used in (E). (**G**) Expression of *Il13ra1* in liver and quadriceps (Quad) muscle of control and pIl13ra1KO mice. n=3 mice/group, 6-8-month-old male mice, experiment performed once. Statistical analysis performed using unpaired Student's t-test (to compare control vs pIl13ra1KO). Values are presented as mean ± SEM. *p<0.05.



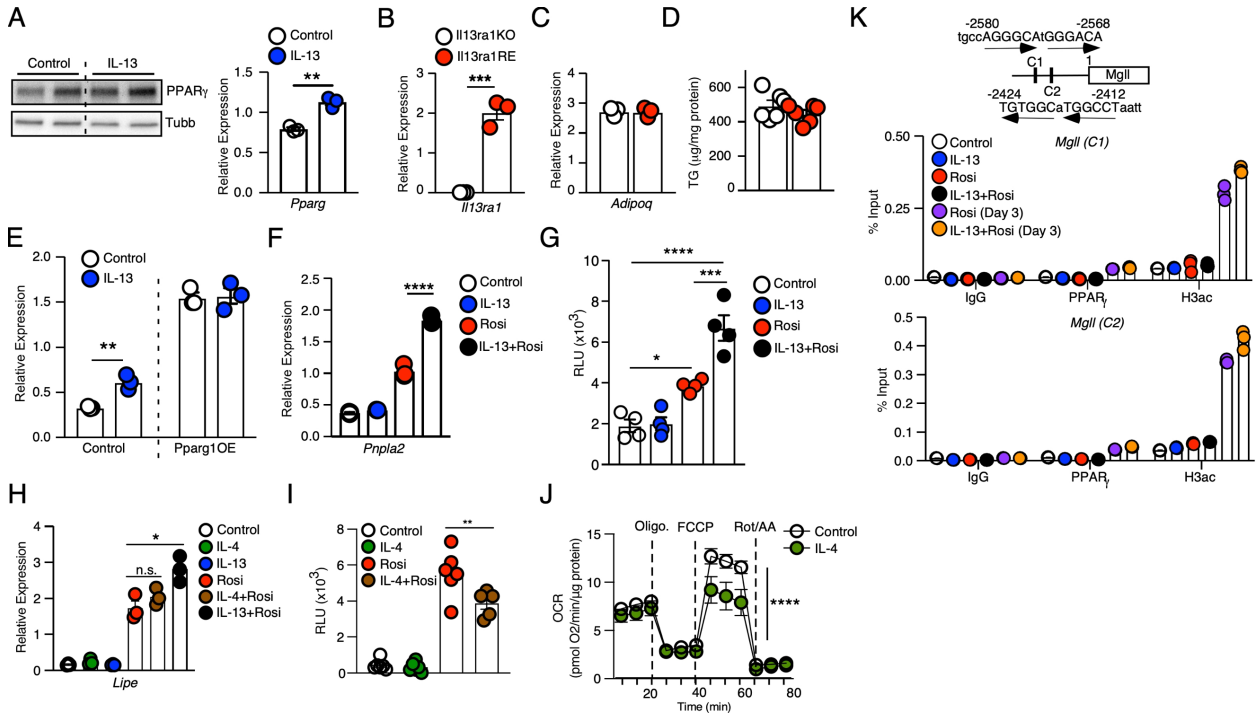

**Supplemental Figure 2. IL-4 is not required for cold-induced beige adipocyte recruitment.** (**A**) The expression of *Il4* and *Il13* by real-time PCR in splenocytes from WT and Il4KO mice stimulated with phorbol myristate acetate (5 ng/ml) and ionomycin (500 ng/ml) for 4 hours. (**B**) Core body temperature of WT and Il4KO mice during a 72-hour cold tolerance test at 4°C. n=4, 6-8-week-old female mice. Statistical analysis performed using 2-way ANOVA. Experiments in (B)-(F) repeated in one additional female cohort and one male cohort that were 12-week-old. (**C**) Assessing the expression of thermogenic genes in iWAT by real-time PCR. 6-8-week-old female mice, n=3 for room temperature at 23°C; n=4 at 4°C. Statistical analysis performed using unpaired Student's t-test (comparing 23°C vs 4°C of the same genotype). (**D**) Immunoblots showing protein levels of UCP1 and mitochondrial OXPHOS complexes II (SDHB), III (UQCRC2), IV (MTCO1), and V (ATP5A) in iWAT of WT and Il4KO mice. Right panel: UCP1 immunoblot signal normalized to the loading control Tubulin (Tubb). Statistical analysis performed using unpaired Student's t-test (comparing 23°C vs 4°C of the same genotype). (**E**) and (**F**) Representative H&E staining of iWAT and BAT, respectively, from mice in (B)-(D). (**G**) Left: Schematic showing neutralizing antibody treatment performed 2 hours before (at the dose of 100 µg/animal) and 24 and 48 hours (at 50 µg) after initiation of a 72-hour cold exposure. Right: Core body temperature of mice receiving anti-IL-13 antibody, anti-IL-4 antibody or IgG control during a 72-hour cold tolerance test at 4°C. n=5/group, 7-8-week-old female mice. Statistical analysis performed using

2-way ANOVA. Experiment performed in one cohort. (**H**) Assessing the expression of thermogenic genes in iWAT by real-time PCR. The room temperature control mice were injected with PBS (n=5). Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**I**) Immunoblots showing protein levels of UCP1 and mitochondrial OXPHOS complexes V (ATP5A), IV (MTCO1), III (UQCRC2) and II (SDHB) in iWAT from mice in (H). Representative tissue samples from 5 mice/group are shown. Right panel: UCP1 immunoblot signal normalized to the loading control Tubulin (Tubb). Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**J**) and (**K**) Representative H&E staining of iWAT and BAT, respectively, from mice in (H). Values are presented as mean ± SEM. *$p<0.05$, **$p<0.01$, ***$p<0.001$, ****$p<0.0001$.



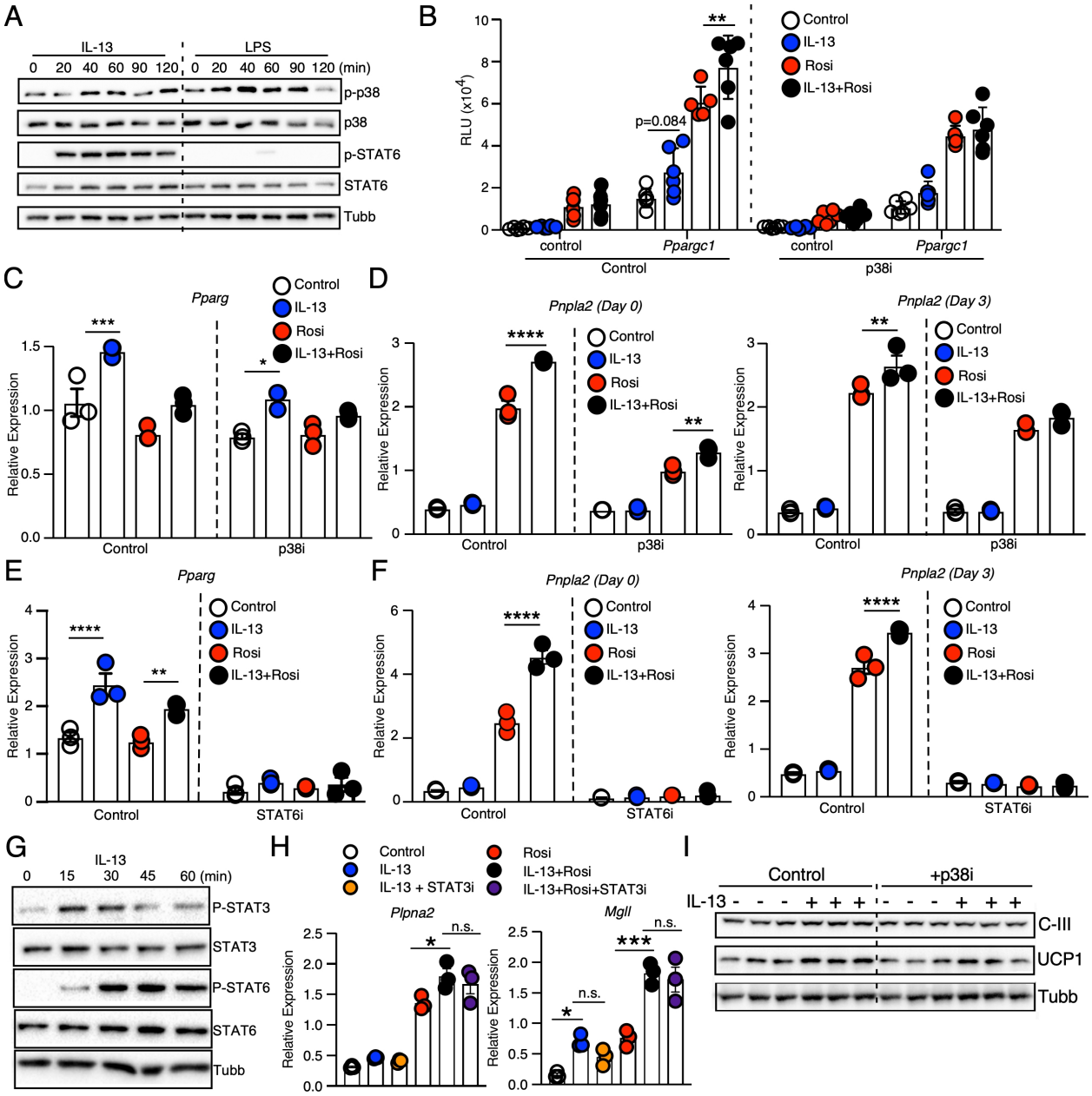

**Supplemental Figure 3. Characterization of immortalized preadipocyte cell line for mechanistic studies.** (**A**) Representative bright field images of WT B6 clonal cell line (referred to as WT) on Days 0, 2, and 5 of differentiation. (**B**) Expression of adipogenic and thermogenic genes measured by RT-qPCR in WT preadipocyte cell line during differentiation. n=3, experiment performed 3 times. (**C**) Expression of *Il13ra1* in WT preadipocytes before (Day 0) and following (Day 6) differentiation. n=3. Statistical significance analyzed using unpaired Student's t-test. (**D**) Expression of *Il13ra1* in primary preadipocytes (Pre) and primary adipocytes (Adipo) isolated from the iWAT of C57B6/J female mice. n=3. Statistical significance analyzed using unpaired Student's t-test. (**E**) Expression of *Il13ra1* in control (shLuc) and *Il13ra1*-knockdown (shIl13ra1) preadipocytes, n=3, experiment performed 2 times. Statistical significance performed using unpaired Student's t-test. (**F**) Oil Red O staining and quantification of differentiated shLuc and shIl13ra1 adipocytes. n=3, experiment performed once. Statistical analysis performed using unpaired Students t-test. (**G**) TG content (n=6, experiment performed 2 times) and (**H**) Expression

of *Adipoq* by RT-qPCR (n=3, experiment performed 3 times) in differentiated shLuc and shIl13ra1 adipocytes. (**I**) Western blotting time course analysis of phosphorylated PKA substrate in WT adipocytes differentiated with or without IL-13 pre-treatment. Adipocytes were differentiated for 6 days and then treated with CL316243 (CL) to induce PKA activity. n=1 well per timepoint. Experiment repeated twice. (**J**) Expression of OXPHOS genes measured by RT-qPCR in shLuc control and shIl13ra1 adipocytes that were pretreated with/without IL-13 for 24 hours and differentiated for 5 days. n=3, experiment performed once. Statistical significance performed using unpaired Student's t-test. (**K**) Immunoblotting of PPARγ protein and mitochondrial OXPHOS complexes II (SDHB), III (UQCRC2), and V (ATP5A) on Days 0, 2, and 5 of differentiation. WT preadipocytes were pretreated with IL-13 or vehicle control before differentiation. Tubb: tubulin as a loading control. n=1, experiment performed once. (**L**) The oxygen consumption rate (OCR) of WT cells treated with/without IL-13 for 24-hours and differentiated for 2 days measured by Seahorse. Oligomycin (Oligo) was used to inhibit coupled respiration. FCCP was added to measure maximal respiration. Rotenone and antimycin A (Rot/AA) were added to inhibit mitochondrial respiration. n=5, experiment performed twice. (**M**) Expression of *Il13ra1* and *Ucp1* in differentiated primary preadipocytes isolated from room temperature (RT) and cold-exposed WT or Il13ra1KO mice. Cold exposure was performed at 4ºC for 72 hours. Primary preadipocytes were harvested from iWAT and differentiated for six days *ex vivo*. n=3. Experiment performed one time. Statistical significance performed using 2-way ANOVA. Values are presented as mean ± SEM. *p<0.05, **p<0.01, ***p<0.001.



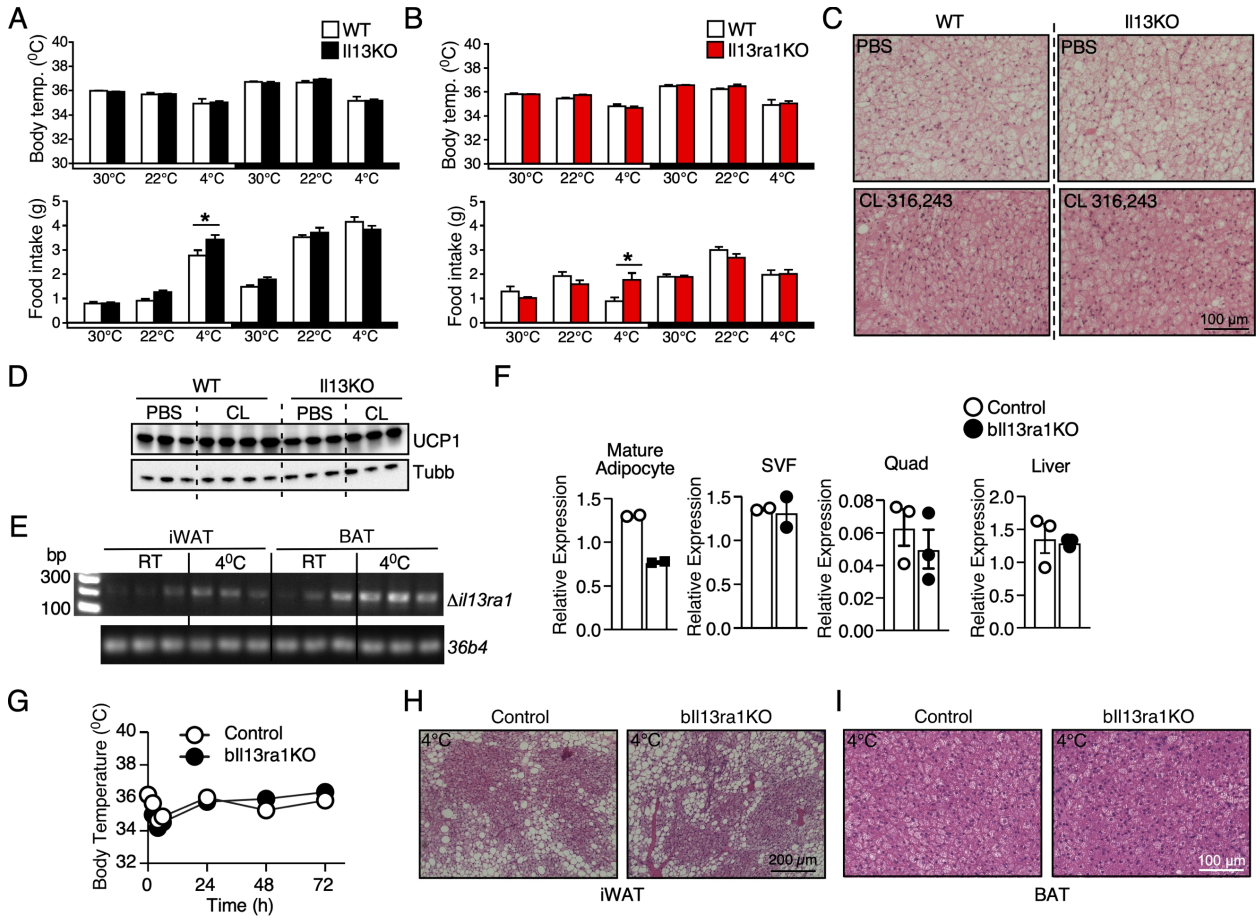

**Supplemental Figure 4. *Pparg* is a direct target of IL-13 in preadipocytes.** (**A**) Immunoblotting of PPARγ protein (left, n=2) and expression of *Pparg* measured by RT-qPCR (right, n=3) in primary SVF isolated from 8-week-old C57BL/6J mice (see Figure 2J). Cells were treated with vehicle control or IL-13 for 24 hours, experiments performed once. Tubb: tubulin as a loading control. (**B**) *Il13ra1*expression measured by RT-qPCR in *Il13ra1*-knockout (Il13ra1KO, with pBabe empty vector as the control) and *Il13ra1*-reexpression (Il13ra1RE) preadipocytes. n=3, experiment performed 3 times. Statistical significance performed using unpaired Student's t-test. (**C**) *Adipoq* expression by RT-qPCR (n=3, experiment performed 2 times) and (**D**) TG content (n=6) in differentiated Il13ra1KO and Il13ra1RE adipocytes. n=3, experiment performed 2 times. Statistical significance performed using unpaired Student's t-test. (**E**) *Pparg* expression by RT-qPCR in Control (pBabe) and *Pparg1*-overexpressing (Pparg1OE) preadipocytes treated with/without IL-13 for 24 hours. n=3, experiment performed 2 times. Statistical analysis performed using unpaired Student's t-test (comparing ±IL-13 within the group). **F**) *Pnpla2* expression measured by RT-qPCR in Pparg1OE preadipocytes treated with control, IL-13, rosi, or IL-13+rosi for 24 hours. n=3, experiment performed once. Statistical analysis performed using one-way ANOVA with Tukey's multiple comparisons test. (**G**) Quantification of PPRE reporter activity in Pparg1OE preadipocytes treated with control, IL-13, rosi, or IL-13+rosi for 24 hours. The PPAR response element (PPRE) containing luciferase reporter was co-transfected with a β-galactosidase internal control. Luciferase activity was measured 48 hours after transfection and normalized to β-galactosidase activity to determine the relative luciferase unit (RLU). n=4, experiment performed 3 times. Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**H)** *Lipe* gene expression in WT preadipocytes treated for 24 hours with vehicle, IL-4, or IL-13 ± rosi. n=3. Statistical analysis performed using one-way ANOVA with Tukey's multiple comparisons test. (**I**) Quantification of PPARγ-LBD transactivation activity on the luciferase reporter in WT preadipocytes treated with control, IL-4, rosi, or IL-4+rosi for 24 hours. Luciferase activity was measured 48 hours after transfection and normalized to β-galactosidase activity to

determine the relative luciferase unit (RLU). n=6, with one outlier excluded from analysis. Statistical analysis performed using one-way ANOVA with Tukey's multiple comparisons test. (**J**) Mitochondrial respiration (determined by the oxygen consumption rate, OCR) of WT preadipocytes treated with vehicle or IL-4 for 24-hours. n=5. Statistical significance performed using 2-way ANOVA. (**K**) Upper panel: Two sets of ChIP primer pairs (C1 and C2) were designed around two potential PPARγ binding sites (PPREs) in the 5' regulatory region of the *Mgll* gene. The transcriptional start site is designated as 1. The arrows indicate two direct repeat motifs of the PPRE. Lower panel: Chromatin immunoprecipitation was performed on preadipocytes treated overnight with IL-13, rosi, or IL-13+rosi and on adipocytes differentiated for three days after overnight rosi or IL-13+rosi pretreatment. Protein-DNA complexes were pulled down using antibodies for IgG control, PPARγ or acetylated histone H3 (H3ac, H3K27ac). Real-time quantitative PCR was performed using C1 and C2 primer pairs. n=3 technical replicates per condition, experiment was performed 3 times. Values are presented as mean ± SEM. *$p<0.05$, **$p<0.01$, ***$p<0.001$, ****$p<0.0001$.



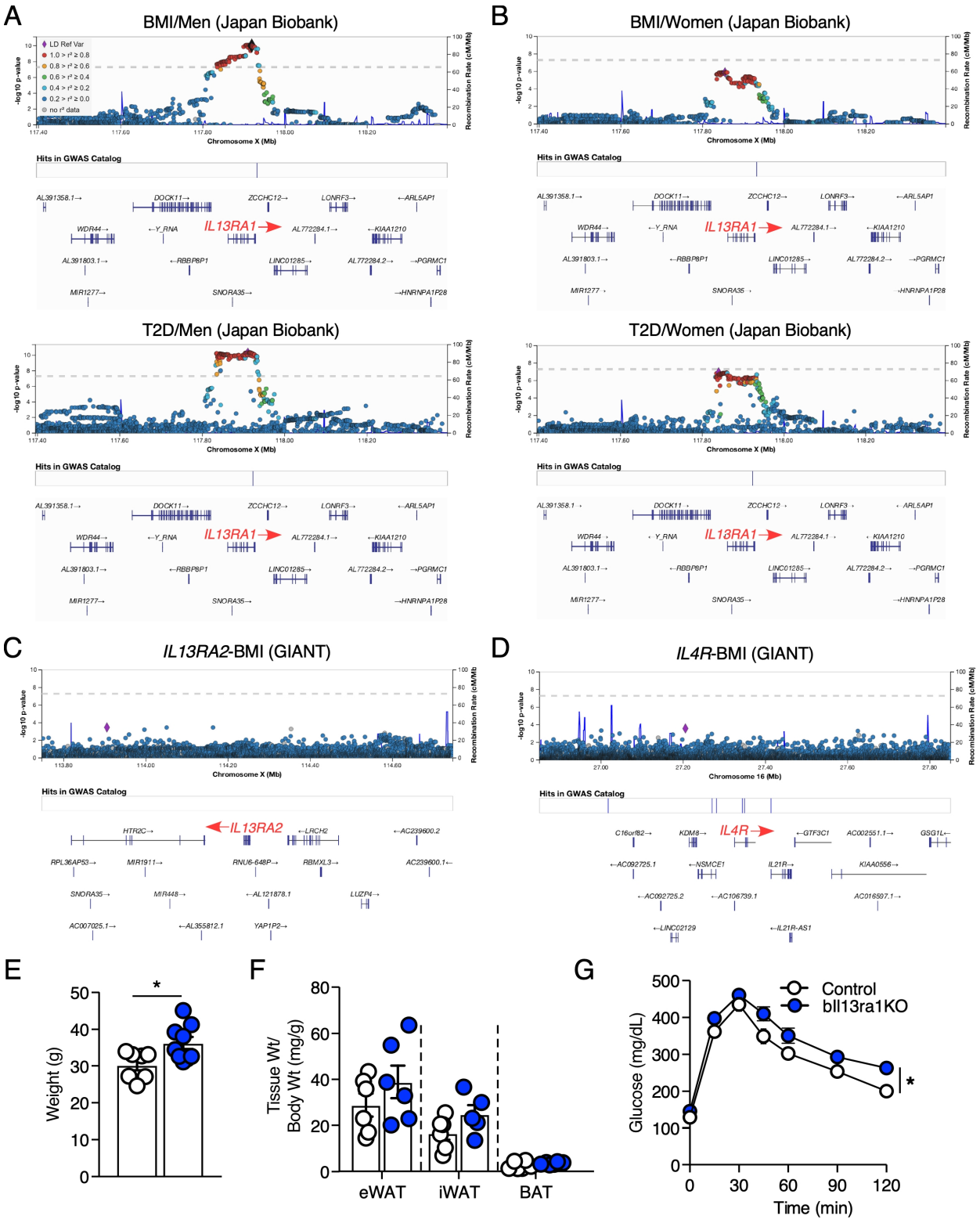

**Supplemental Figure 5. IL-13/IL-13Rα1 activates p38 MAPK and STAT6 to modulate PPARγ activity.** (**A**) Immunoblot analysis of STAT6, phospho-STAT6 (p-STAT6), p38-MAPK, and phospho-p38-MAPK (p-p38) in preadipocytes treated IL-13 or LPS for 0-120 minutes. n=1 per timepoint, experiment performed 2 times. LPS serves as a control for p38 activation. Tubb: tubulin as a loading control. (**B**) Quantification of PPARγ-LBD transactivation activity in WT preadipocytes co-transfected with the luciferase reporter, Gal4-PPARγ-LBD and control vector or *Ppargc1a* expression vector. Cells were treated with vehicle control, IL-13, rosi, or IL-13+rosi for 24 hours ± P38 inhibitor (P38i). Luciferase activity was measured 48 hours after transfection and normalized to protein content to determine the relative luciferase unit (RLU). n=6, experiment performed 3 times. Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**C**) *Pparg* expression measured by RT-qPCR in WT preadipocytes treated with

vehicle control, IL-13, rosi, or IL-13+rosi for 24 hours with/without P38i. n=3, experiment performed twice with P38i. Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**D**) Expression of the PPARγ target gene *Pnpla2* measured by RT-qPCR in WT preadipocytes treated with vehicle control, IL-13, rosi, or IL-13+rosi ± P38i for 24 hours. *Pnpla2* expression was determined right after the 24-hour treatment (Day 0) or following 3 days of differentiation (Day 3). n=3, experiment performed 2 times for Day 0, once for Day 3. Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**E**) *Pparg* expression measured by RT-qPCR in WT preadipocytes treated with vehicle control, IL-13, rosi, or IL-13+rosi for 24 hours with/without STAT6i. n=3, experiment performed once. Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. (**F**) *Pnpla2* expression measured by RT-qPCR in WT preadipocytes right after the 24-hour treatment (Day 0) or following 3 days of differentiation (Day 3). Statistical analysis performed using 2-way ANOVA with Tukey's multiple comparisons test. n=3, experiments performed once. (**G**) Immunoblotting of STAT3 and STAT6 phosphorylation in WT preadipocytes treated with IL-13 for 0, 15, 30, 45, or 60 minutes. Experiment performed once. (**H**) Gene expression from WT preadipocytes treated 24 hours with vehicle control, IL-13, rosi, IL-13+rosi ± STAT3 inhibitor (STAT3i) for 24 hours. n=3. Statistical analysis performed using 1-way ANOVA with Tukey's multiple comparisons test. (**I**) Immunoblotting showing complex III (UQCRC2) and UCP1 protein levels in differentiated adipocytes. Preadipocytes were pretreated with rosi plus IL-13 or vehicle ± p38i for 24 hours, followed by differentiation for 5 days. n=3, experiment performed once. Values are presented as mean ± SEM. *$p<0.05$, **$p<0.01$, ***$p<0.001$, ****$p<0.0001$.




**Supplemental Figure 6. Intact brown adipose tissue function in mice lacking IL-13 signaling.** (**A**) Core body temperature and food intake of WT and Il13KO mice housed at 30°C, 22°C and 4°C in metabolic cages for 72 hrs. Data presented as average temperature for light and dark cycles after 48 hours acclimation at each temperature. n=6, 20-week-old male mice, experiment performed once. Statistical analysis performed with unpaired Student's t-test (comparing WT and Il13KO). (**B**) Core body temperature and food intake of WT and Il13ra1KO mice housed at 30°C, 22°C and 4°C for 72 hrs. Data presented as average temperature for light and dark cycles after 48 hours acclimation at each temperature. n=5-7 per group, 24-week-old male mice, experiment performed once. Statistical analysis performed with unpaired Student's t-test (comparing WT and Il13ra1KO). (**C**) Representative H&E staining images of BAT and (**D**) Immunoblotting showing UCP1 protein in BAT from WT and Il13KO mice injected with PBS or CL for 10 days. n=3-4 per group, 3-month-old males, experiment performed once. Tubb: tubulin as a loading control. (**E**) Genomic DNA validation of *Il13ra1* gene deletion (~300 base-pair excised fragment) by qPCR in iWAT and BAT from iWAT of bIl13ra1KO mice housed at room temperature (RT) or 4°C. n=3 mice/group; 3-month-old male mice. Products of qPCR were visualized on an agarose gel. Experiment performed once. (**F**) *Il13ra1* expression measured by RT-qPCR in mature primary adipocytes and SVF from iWAT, quadriceps muscle and liver of control and bIl13ra1KO mice. For quad and liver n=3, 6-8-month-old male mice, experiment performed once; n=2 replicates for primary adipocytes and SVF pooled from 3 mice per genotype, 5-6-month-old male mice. Experiments performed once. (**G**) Core body temperature of control and bIl13ra1KO mice during

a 72-hour cold tolerance test at 4°C. n=6, 6-week-old male mice, experiment performed twice. Statistical analysis performed using 2-way ANOVA. (**H**) and (**I**) Representative H&E staining images of iWAT and BAT from mice in (G). Values are presented as mean ± SEM. *$p<0.05$.




**Supplemental Figure 7. Association of genetic variants at *IL13RA1* with body mass index (BMI) and type 2 diabetes (T2D).** (**A**) and (**B**) *IL13RA1* genetic variants are associated with BMI and T2D in a Japanese population (data acquired from BioBank Japan based on published GWAS,

see Methods). The regional association plot was generated by Locuszoom (https://my.locuszoom.org/) on -log10 p values for each genetic variant's association with the trait. Each dot is a genetic variant, and the diamond shaped dot indicates the lead variant (i.e., variant with the smallest p value). Colors of the dots indicate LD relationship ($r^2$) between all genetic variants to the lead variants. Minor allele frequency (MAF) was not included. (**C**) and (**D**) No genome-wide significant association with BMI at the *IL13RA2* and *IL4R* loci, based on published GWAS summary data from a GIANT Consortium study (see Methods). (**E**) Body weight and (**F**) Fat tissue weight normalized to body weight of Control and bIl13ra1KO mice. n=7-9/group, 4-month-old males. Statistical significance performed using unpaired Student's t-test. Experiment repeated in two separate cohorts. (**G**) GTT of Control and bIl13ra1KO mice. n=6 Control, n=10 bIl13ra1KO, 3-month-old males, experiment repeated in 3 separate cohorts. Statistical significance determined with 2-way ANOVA. Values are presented as mean ± SEM. *$p<0.05$.

**Supplemental Table 1. Animal Cohorts**

| Experiment | Genotype/Number of Mice | M/F | Age | Figures |
|---|---|---|---|---|
| WT vs. Il13KO 72-hour cold exposure | WT: n=6 22°C, n=6 4°C;<br>Il13KO: n=5 22°C, n=5 4°C | Female | 8 weeks | Fig. 1A-C<br>Fig. S1A-B<br>Fig. 2K |
| Flox control vs. pAdIl13ra1KO 72-hour cold exposure | Control: n=5 4°C<br>pIl13ra1KO: n=5 4°C | Male | 5-7 weeks | Fig. 1D-G<br>Fig. S1C-E<br>Fig. 6F-H |
| WT vs. Il4KO 72-hour cold exposure | WT: n=3 23°C, n=4 4°C;<br>Il4KO: n=3 23°C, n=4 4°C | Female | 6-8 weeks | Fig. S2A-F |
| PBS injected vs neutralizing antibodies injected 72-hour cold exposure | Control: n=5 PBS 23°C<br>IgG control: n=5 4°C<br>Anti-IL-13: n=5 4°C<br>Anti-IL-4: n=5 4°C | Female | 7-8 weeks | Fig. S2G-K |
| WT vs. Il13KO 10-day CL injection | WT: n=5 PBS, n=5 CL<br>Il13KO: n=3 PBS, n=4 CL | Male | 12 weeks | Fig. 5A-B<br>Fig. S6C-D |
| WT vs. Il13ra1KO CL injection | WT: n=4<br>Il13ra1KO: n=4 | Male | 30 weeks | Fig. 5C-D |
| Flox control vs. bIl13ra1KO 7-day CL injection | Control: n=3 non-injected, n=7 CL<br>bIl13ra1KO: n=3 non-injected, n=6 CL | Female | 20 weeks | Fig. 5E-F |
| WT vs. Il13KO adult temperature and food intake (metabolic cages) | n=5-7/group | Male | 20 weeks | Fig. S6A |
| WT vs. Il13ra1KO adult temperature and food intake (metabolic cages) | n=5-7/group | Male | 24 weeks | Fig. S6B |
| Flox control vs. bIl13ra1KO 72-hour cold exposure | Control: n=6 4°C<br>bIl13ra1KO: n=6 4°C | Male | 6 weeks | Fig. S6G-I |
| WT vs. Il13ra1KO Body/Tissue Weights/GTT | WT: n=5<br>Il13ra1KO: n=6 | Male | 20 weeks | Fig. 6C-E |
| Flox control vs. bIl13ra1KO Body/Tissue Weights/GTT | GTT: n=6 control, n=9 bIl13ra1KO<br>Weights: n=6 control, n=6 bIl13ra1KO | Male | GTT 12 weeks; weights 16 weeks | Fig. S7E-G |
| Flox control vs. pIl13ra1KO GTT | Control: n=7<br>pIl13ra1KO: n=7 | Female | 20 weeks | Fig.6H |

**Supplemental Table 2**. **List of Primer Sequences for qPCR**

| Gene | Primer Bank ID | Forward Sequence | Reverse Sequence |
|---|---|---|---|
| 36b4 | N/A | AGATGCAGCAGATCCGCAT | GTTCTTGCCCATCAGCACC |
| Il13ra1 | N/A | CCCTGAAGGTGATCCTGAGT | TAGTGTGTGTCAGGGCTTGT |
| Ucp1 | N/A | GGCCCTTGTAAACAACAAAATAC | GGCAACAAGAGCTGACAGTAAAT |
| Cox8b | N/A | GAACCATGAAGCCAACGACT | GCGAAGTTCACAGTGGTTCC |
| Dio2 | N/A | CATGCTGACCTCAGAAGGGC | CCAGTTTAACCTGTTTGTAGGCA |
| Ndufb9 | N/A | GGCATCCCTCTGAGAAAGCA | GCTTAACCTCCCGATCCCAG |
| Sdhb | N/A | TGCAGTTTCAGGCCTGTCGAG | AGGTCCGCACTTATTCAGATCCA |
| Atp5k* | 6671592a1 | GTTCAGGTCTCTCCACTCATCA | CGGGGTTTTAGGTAACTGTAGC |
| Ndufs5 | N/A | GCAAGATAGAGTTCGATGACTTCGA | TCTCCCGCTGTTTCTTGAATCA |
| Pparg* | 187960104c1 | GGAAGACCACTCGCATTCCTT | GTAATCAGCAACCATTGGGTCA |
| Adipoq* | 87252710c2 | GAAGCCGCTTATGTGTATCGC | GAATGGGTACATTGGGAACAGT |
| Pnpla2 | N/A | CCTTAGGAGGAATGCCCTGC | AGCATGTTGGAAAGGGTGGT |
| Mgll* | 6754690a1 | CGGACTTCCAAGTTTTTGTCAGA | GCAGCCACTAGGATGGAGATG |
| Lipe | N/A | ACACAAAGGCTGCTTCTACG | CTCGTTGCGTTTGTAGTGCT |
| Abcd2* | 6752942a1 | ATACACATGCTAAATGCAGCAGC | GCCAATGATGGGATAGAGGGT |
| Pparg1 | N/A | CAGGAGCCTGTGAGACCAAC | ACCGCTTCTTTCAAATCTTGTCTG |
| Bscl2* | 236465188c2 | TCCTTCTACTACTCCTACATGCC | GGCGGTGGAGGAATCACAG |
| Cebpa* | 6680916a1 | CAAGAACAGCAACGAGTACCG | GTCACTGGTCAACTCCAGCAC |
| Lpl* | 6678710a1 | GGGAGTTTGGCTCCAGAGTTT | TGTGTCTTCAGGGGTCCTTAG |
| Adrb3* | 133891719c3 | CCTTGGGCGAAACTGGTTG | GTTGGTGACAGCTAGGTAGCG |
| Lipe (C1) | PPRE ChIP | GGCGGTAAATTACCACACG | GCACAACTAAATGACTGGCC |
| Lipe (C2) | PPRE ChIP | CATAGGACCCAGTCCTGACAG | CTGTCCTCGGAGAAACCTCTC |
| Mgll (C1) | PPRE ChIP | GCTGTGAGATAATTCACTTCC | GCTGAGGGAGAAACTGCTTTC |
| Mgll (C2) | PPRE ChIP | CACTGCACACAAATGAGACG | CAAATCCACCGGGGAAAGAC |

*Primer sequences were acquired from the MGH Primer Bank

**Supplemental Table 3. List of Antibodies and Key Reagents**

| Type | Designation | Vendor | Catalog # |
|---|---|---|---|
| Antibody | Rabbit monoclonal anti-β-Tubulin | Cell Signaling Technology | 2146 |
| Antibody | Rabbit polyclonal anti-UCP-1 | Abcam | ab23841; ab209483 |
| Antibody | Mouse anti-Total OXPHOS Cocktail | Abcam | ab110413 |
| Antibody | Mouse monoclonal anti-PPARγ (E-8) | Santa Cruz Biotechnology | sc-7273 |
| Antibody (ChIP) | Rabbit monoclonal anti-PPARγ (81B8) | Cell Signaling Technology | 2443 |
| Antibody (ChIP) | Rabbit monoclonal anti-acetyl-Histone H3 (Lys27) (D5E4) | Cell Signaling Technology | 8173 |
| Antibody | Rabbit polyclonal anti-β3 adrenergic receptor | Abcam | ab94506 |
| Antibody | Rabbit polyclonal anti-HSL | Cell Signaling Technology | 4107 |
| Antibody | Rabbit polyclonal anti-p38-MAPK | Cell Signaling Technology | 9212 |
| Antibody | Rabbit polyclonal anti-Phospho-p38 MAPK (Thr180/Tyr182) (3D7) | Cell Signaling Technology | 9215 |
| Antibody | Rabbit polyclonal anti-STAT6 | Cell Signaling Technology | 9362 |
| Antibody | Rabbit polyclonal anti-Phospho-STAT6 (Tyr641) | Cell Signaling Technology | 9361 |
| Antibody | Rabbit monoclonal anti-STAT3 (D3Z2G) | Cell Signaling Technology | 12640 |
| Antibody | Rabbit monoclonal anti-Phospho-STAT3 (Tyr705) (D3A7) | Cell Signaling Technology | 9145 |
| Antibody | Rabbit polyclonal anti-Phospho-HSL (S660) | Cell Signaling Technology | 45804 |
| Antibody | Rabbit monoclonal anti-Phospho-PKA Substrate (RRXS*/T*) (100G7E) | Cell Signaling Technology | 9624 |
| Antibody | Rabbit monoclonal anti-Hsp60 (EP1006Y) | Abcam | Ab45134 |
| Antibody | *InVivo*MAb mouse IgG1 isotype control (MOPC-21) | BioXCell | BE0083 |
| Antibody | *InVivo*MAb anti-mouse IL-4, (11B11) | BioXCell | BE0045 |
| Antibody | Anti-mIL-13-mIgG1 InvivoFit™ (8H8) | InvivoGen | mil13-mab9-1 |
| Recombinant protein | Recombinant mouse IL-13 protein | R&D Systems | 413-ML |
| Recombinant protein | Lipopolysaccharides from *Escherichia coli* K-235 | Sigma-Aldrich | L2143 |
| Recombinant protein | Insulin from bovine pancreas | Sigma-Aldrich | I6634 |

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|---|---|---|---|
| Recombinant DNA Reagent | pBABE-puro retroviral expression vector (plasmid) | Addgene | Plasmid #1764 |
| Recombinant DNA Reagent | pBABE-Il13ra1 (plasmid) | | |
| Recombinant DNA Reagent | pBABE-Pparg1 (plasmid) | | |
| shRNA | shIl13ra1 forward sequence for plasmid generation: GACGGATCCCTGGAAGAAGTATGAC ATCTATTCAAGAGATAGATGTCATAC TTCTTCCAGTTTTTTTGATATCGAATT CGCC | | |
| shRNA | shIl13ra1 reverse sequence for plasmid generation: GGCGAATTCGATATCAAAAAAACTGG AAGAAGTATGACATCTATCTCTTGAAT AGATGTCATACTTCTTCCAGGGATCCG TC | | |
| Chemical compound | 3-Isobutyl-1-methylxanthine (IBMX) | Sigma-Aldrich | I5879 |
| Chemical compound | Dexamethasone | Sigma-Aldrich | D4902 |
| Chemical compound | Rosiglitazone | Sigma-Aldrich | R2408 |
| Chemical compound | CL 316,243 | Tocris | 1499 |
| Chemical compound | Oligomycin | Abcam | ab141829 |
| Chemical compound | FCCP | Cayman Chemical Company | 15218 |
| Chemical compound | Rotenone | Abcam | ab143145 |
| Chemical compound | Antimycin A | Sigma-Aldrich | A8674 |
| Chemical compound | p38-MAPK inhibitor (SB 203580) | Abcam | ab120162 |
| Chemical compound | STAT6 inhibitor (AS1517499) | Selleck Chemicals | S8685 |
| Chemical compound | STAT3 inhibitor (Stattic) | Cayman | 14590 |

| | | | |
|---|---|---|---|
| Chemical compound | Seahorse XF24 FluxPak | Agilent | 102070-00 |
| Assay kit | Infinity™ Triglycerides Liquid Stable Reagent | ThermoFisher Scientific | TR22421 |
| Assay kit | Glycerol Assay Kit | Sigma-Aldrich | MAK117 |
| Assay kit | BCA Protein Assay Kit | Pierce | 23223, 1859078 |
| Assay kit | Luciferase Activity Assay | Promega | E1501 |
| Assay kit | SimpleChIP Plus Kit (magnetic beads) | Cell Signaling Technology | 9005 |
| Liquid medium | Dulcecco's Modified Eagle's Medium, 4.5g/L glucose | Corning | 10-013- CV |
| Liquid medium | FBS | Gibco | 10437-028 |
| Liquid medium | FB Essence | VWR | 3100-500 |
| Cell line | AD293 (human embryonic kidney epithelial cells) | Agilent | 240085 |
| Cell line | Phoenix-AMPHO (human kidney epithelial cells) | ATCC | CRL-3213 |
| Mouse strain | C57BL6/J | Jackson Laboratory | 000664 |
| Mouse diet | PicoLab® Mouse Diet 20 | PicoLab | 5058 |
| Other | Verso cDNA synthesis kit | ThermoFisher Scientific | AB1453B |
| Other | NucleoSpin RNA Plus kit | Macherey-Nagel | 740984 |
| Other | GeneJET Genomic DNA Purification Kit | ThermoFisher Scientific | K0721 |
| Other | Collagenase, Type II, powder | Gibco | 17101-015 |
| Other | Bovine serum albumin | Gemini Bio-Products | 700-107P |
| Other | TranslT-LT1 Transfection Reagent | Mirus Bio | MIR 2300 |

**Supplemental Dataset 1 (separated file).** List of differentially expressed genes ($p<0.01$) of differentiated adipocytes identified by RNA-seq comparing IL-13 priming prior to differentiation vs control. n=4.

**Supplemental Dataset 2 (separated file).** List of differentially expressed genes (FDR<0.01) of preadipocytes identified by RNA-seq comparing IL-13 treatment (24 hours) vs control. n=4.