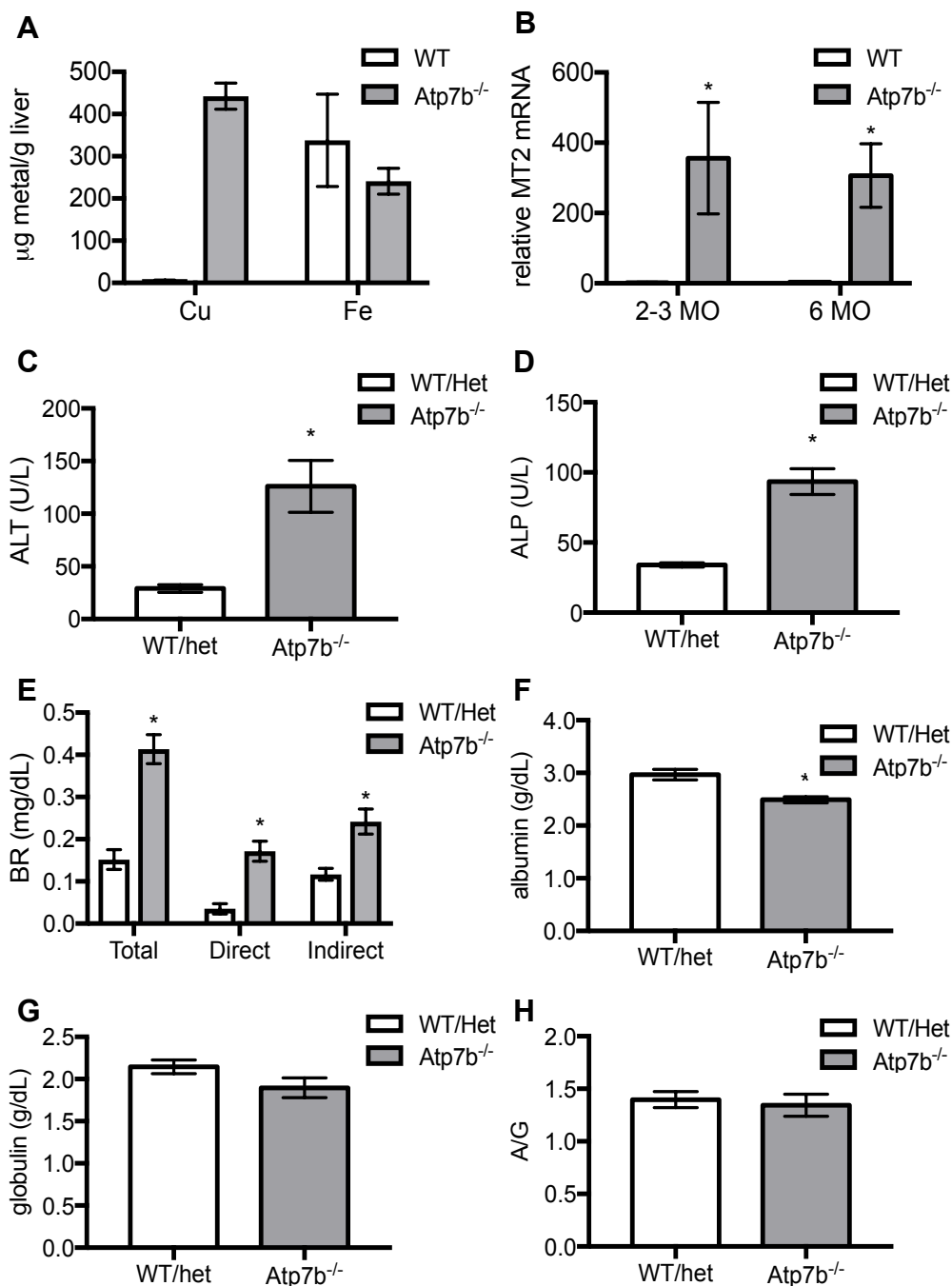
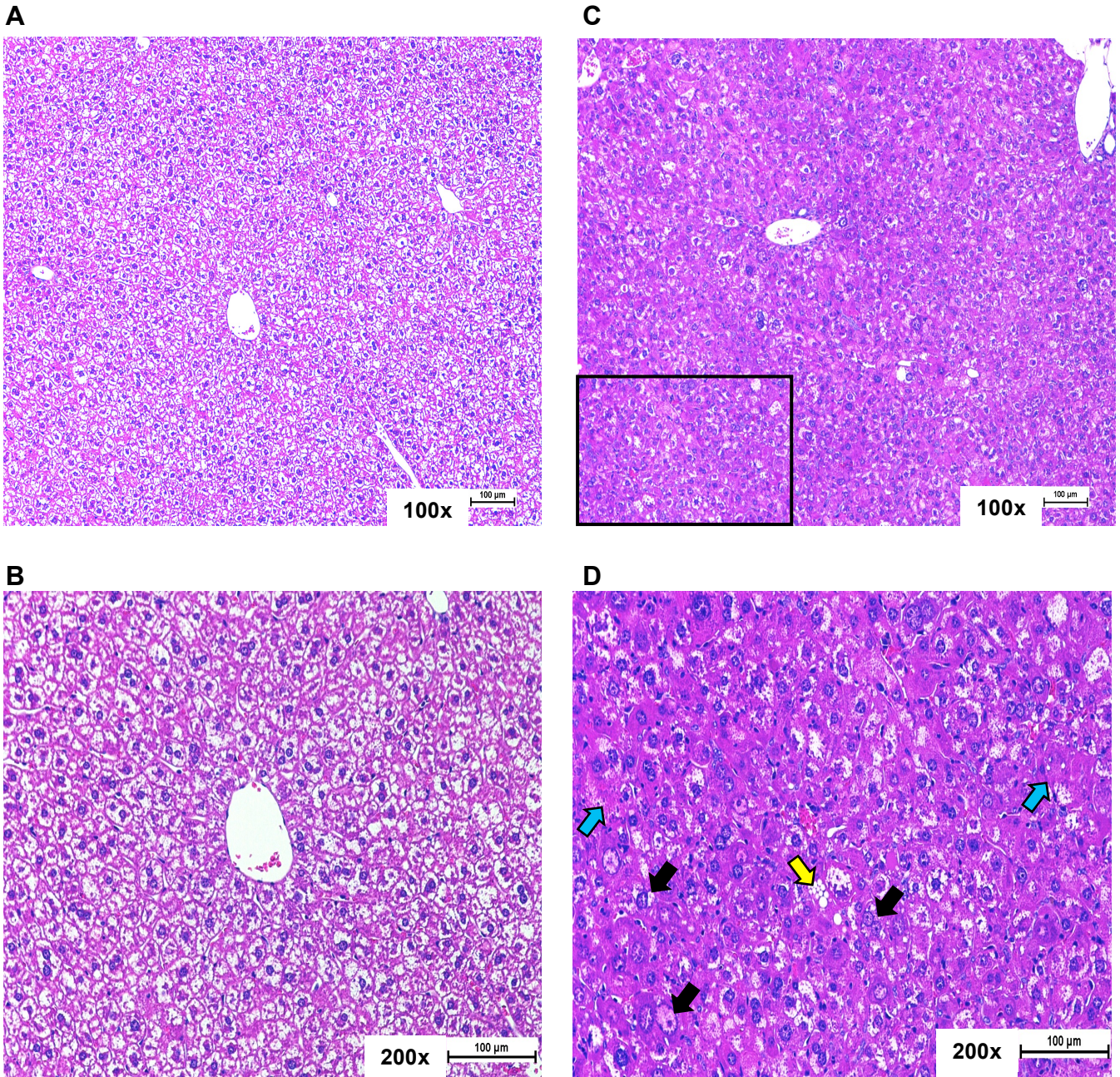


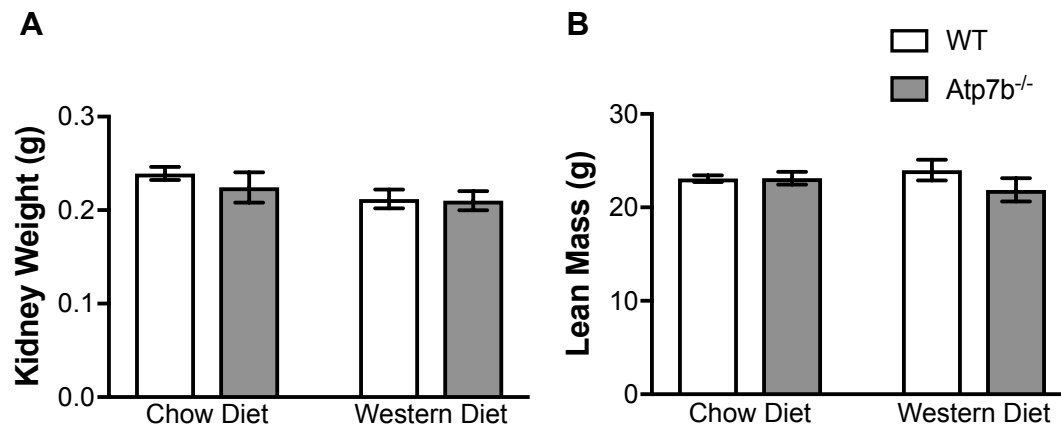
Wooton-Kee et al. Supplemental Material



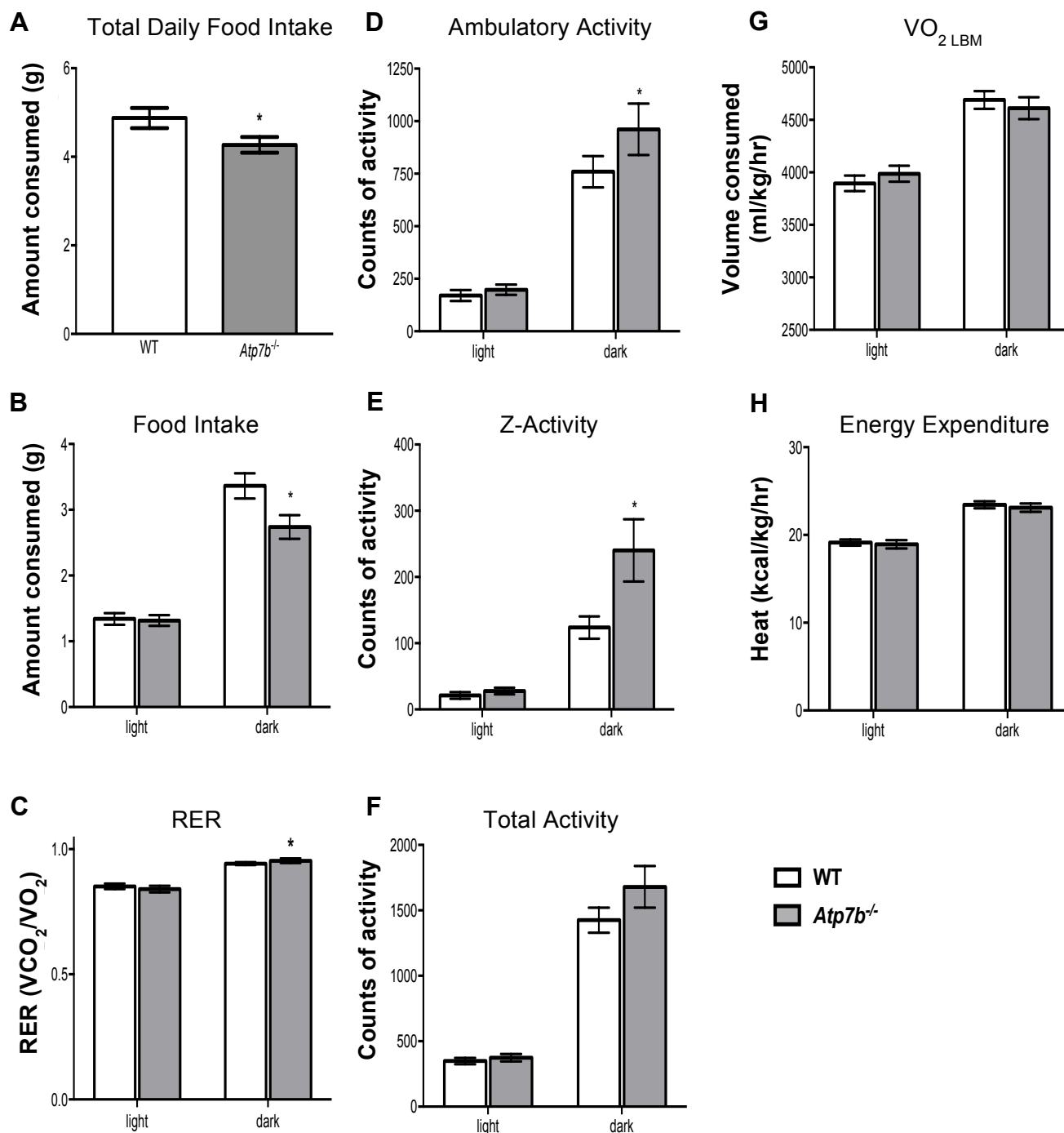
Supplemental Figure 1. Metal concentrations, metallothionein expression and liver function in WT and *Atp7b*^{-/-} mice. (A) Hepatic copper (Cu) and iron (Fe) measurements in WT and *Atp7b*^{-/-} mice at 3-7 months of age. n = 2 for WT, and n = 3 for *Atp7b*^{-/-} mice. (B) Hepatic metallothionein 2 (*Mt2*) expression in WT and *Atp7b*^{-/-} mice aged 2-3 and 6 months of age. (C-H) Serum chemistry measurements in WT and *Atp7b*^{-/-} mice, aged 5-7 months old. (C) alkaline transaminase (ALT), (D) alkaline phosphatase, (E) bilirubin, (F) albumin, (G) globulin, (H) albumin/globulin ratio. Shown are the mean \pm SEM for n = 5 samples, * P < 0.05, Student's t-test.



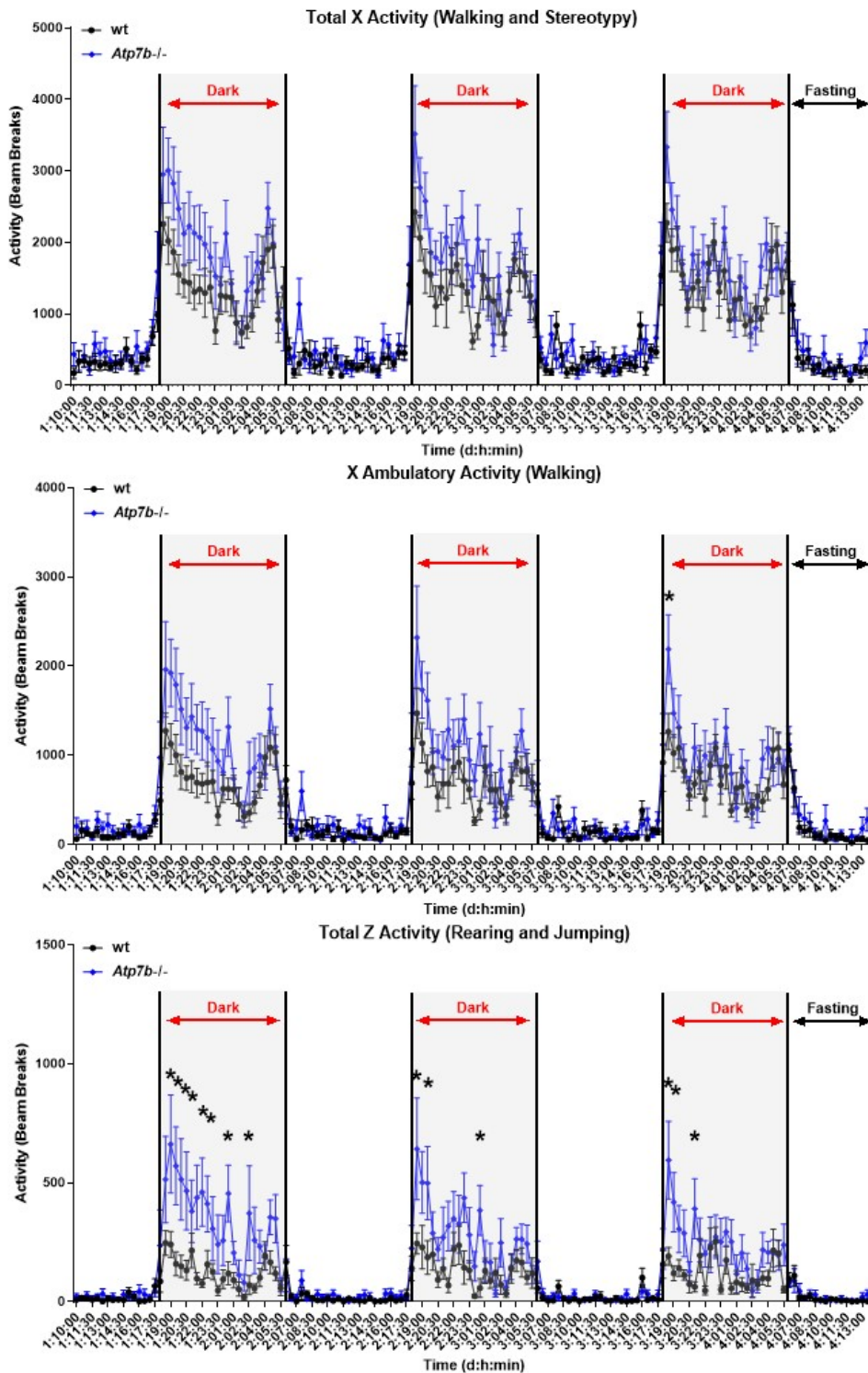
Supplemental Figure 2. H&E staining of WT and *Atp7b*^{-/-} livers. H&E staining of 6-month old (A, B) WT and (C, D) *Atp7b*^{-/-} mice on chow diet at 10x (A, B) and 20x (C, D) magnification. Black arrows point to eosinophilic nuclear inclusions. Yellow arrows point to microsteatosis. Blue arrows show hepatocyte ballooning.



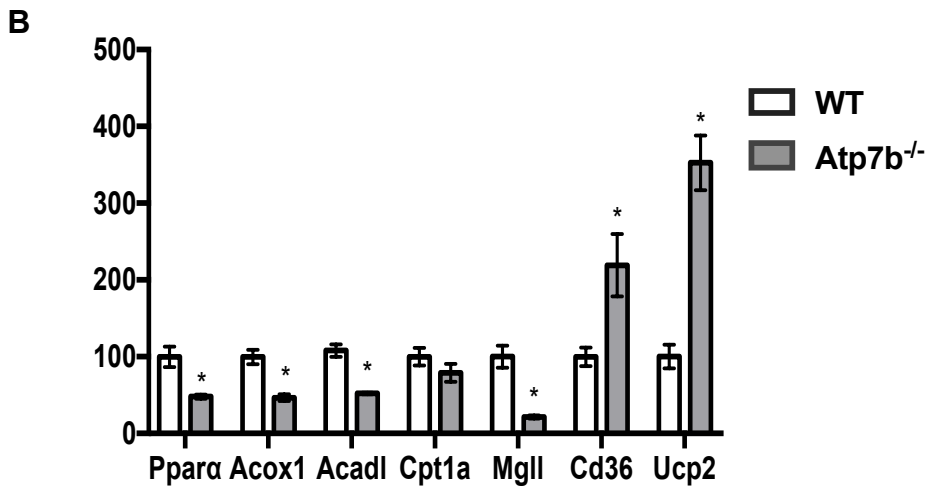
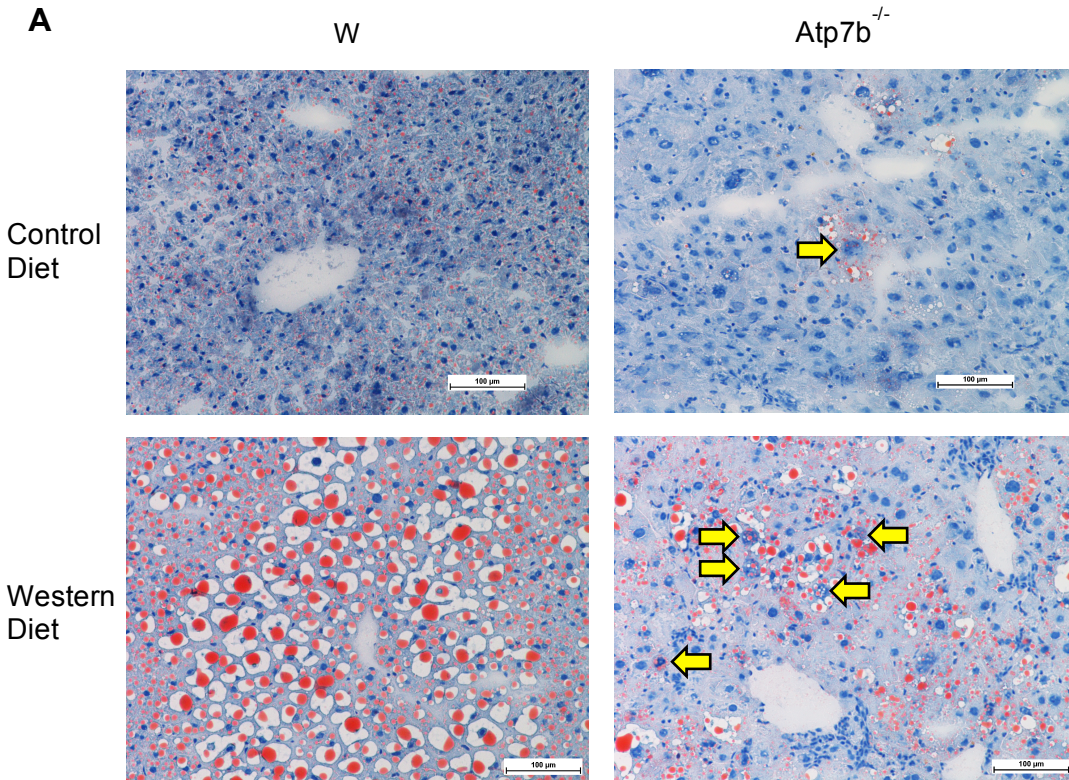
Supplemental Figure 3. Global *Atp7b* deficiency does not affect lean body mass in mice. (A) kidney or lean body (B) mass. N=5-11 per group.



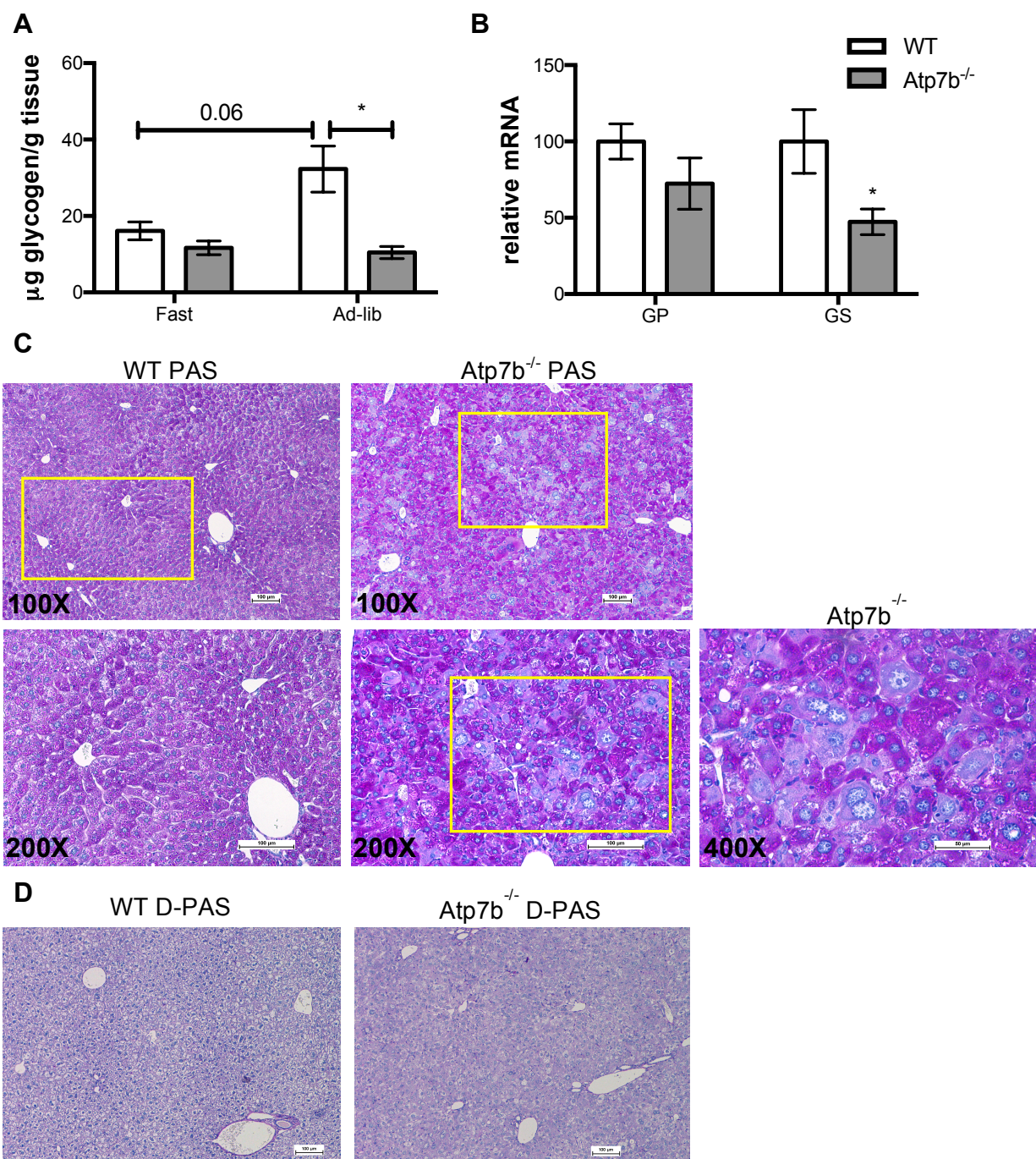
Supplemental Figure 4. Indirect calorimetry, food intake, and activity in *Atp7b*^{-/-} wild-type (WT) mice. (A) Food intake, (B) total daily food intake, (C) respiratory exchange ratio (RER), (D) ambulatory activity, (E) Z-activity, (F) total activity, (G) VO₂ normalized to lean body mass, (H) and energy expenditure (heat) normalized to lean body mass were determined using Oxymax/CLAMS. Differences between *Atp7b*^{-/-} vs. WT mice during either the light or dark cycle or between genotypes. *P<0.05, Student's t-test, N=11 per group.



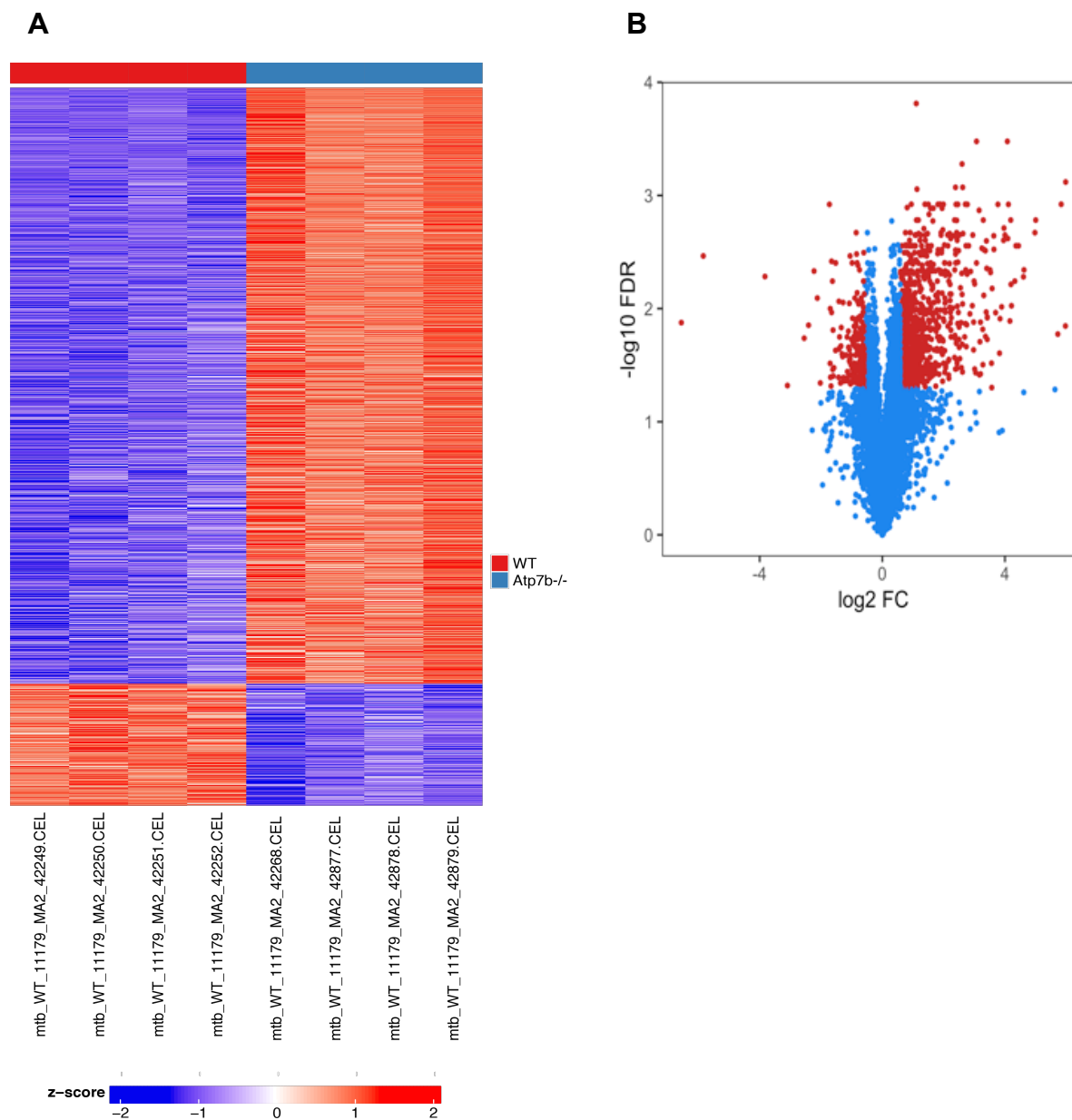
Supplemental Figure 5. Activity vs time data reveal increased amplitude of X ambulatory and Z- activity during dark (active) cycle for *Atp7b*^{-/-} mice in comparison with WT littermate controls. Time-course data for the final 3 days of CLAMS/Oxymax experiments. *P<0.05, *Atp7b*^{-/-} vs WT, repeated-measures ANOVA, Sidak post-hoc test, N=11 per group.



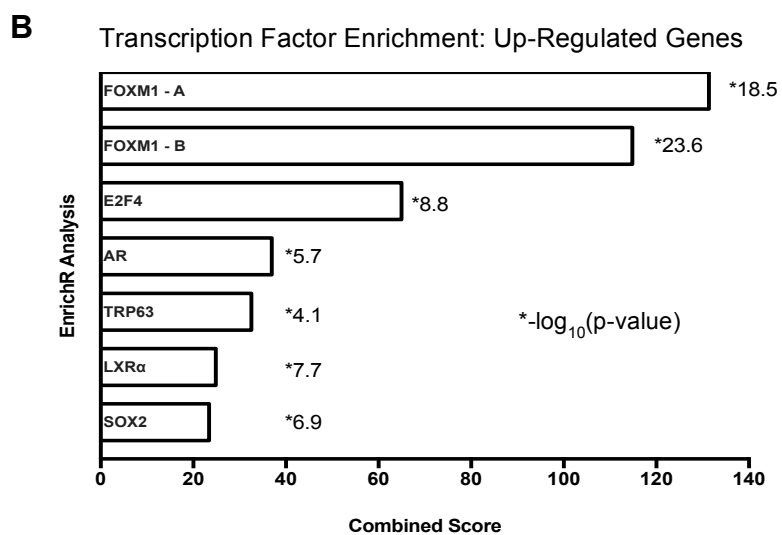
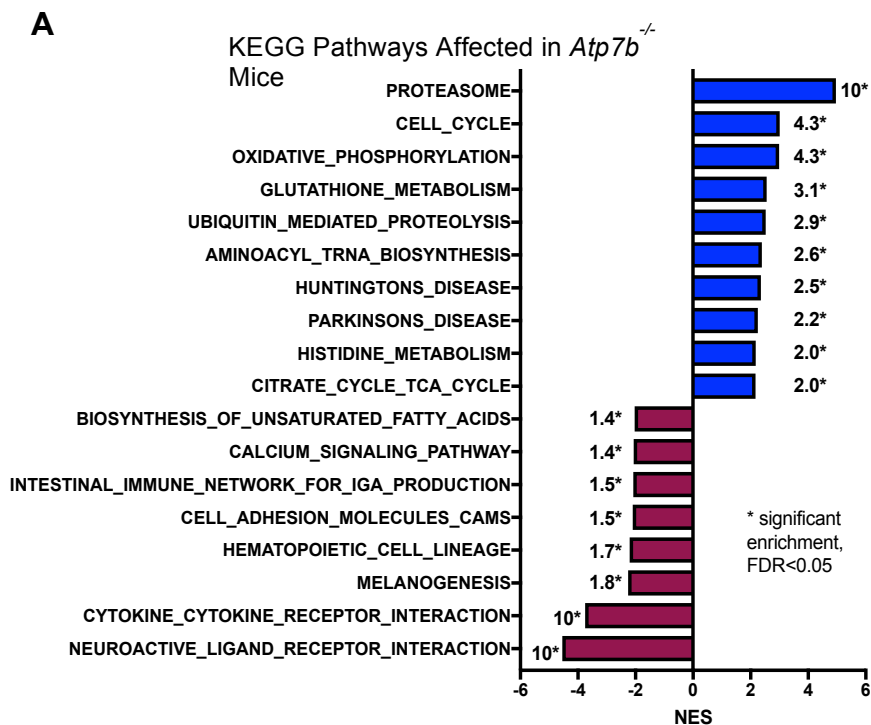
Supplemental Figure 6. Hepatic lipid content is reduced in *Atp7b*^{-/-} mice. (A) Oil Red O (ORO) staining of Control (Chow) diet- vs Western diet-fed WT and *Atp7b*^{-/-} livers. Black arrows - microsteatosis; yellow arrows - nuclei containing ORO staining. (B) Changes in hepatic fatty acid oxidation regulatory gene expression. N=5-11 mice per group. Student's t-test was used to determine differences between age-matched *Atp7b*^{-/-} mice vs. WT controls, * P<0.05 vs. WT.



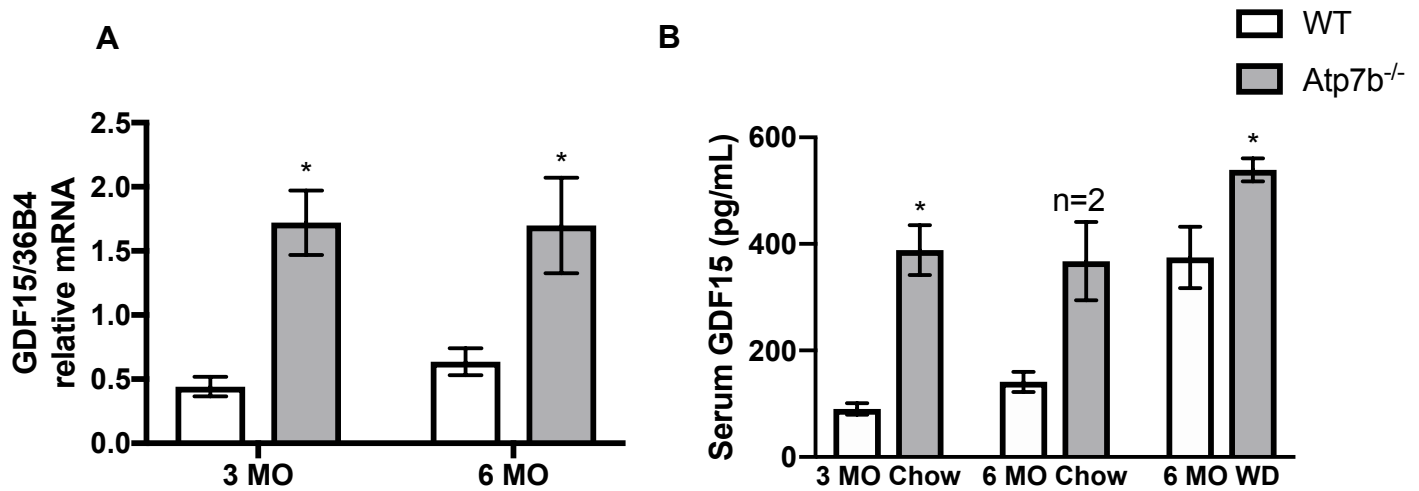
Supplemental Figure 7. Hepatic glycogen content is decreased in *Atp7b*^{-/-} mice. (A) colorimetric glycogen assays in 4-6-month-old animals fasted for 6 hours or ad lib fed chow diet. (B) Real-time PCR analysis of GP – glycogen phosphatase, GS– glycogen synthetase mRNA for ad lib chow diet-fed 6-month-old *Atp7b*^{-/-} mice and WT controls. (C) Glycogen content shown by PAS staining (D) D-PAS – digested negative control. Yellow boxes highlight low glycogen areas. Statistical analysis was performed by (A) Un-paired Student's t-test, *P<0.05, n=5 mice per group, (B) 2-Way ANOVA, followed by Sidak's post-hoc test. * P<0.05, WT vs. *Atp7b*^{-/-}. N=4 mice per group.



Supplemental Figure 8. Microarray analysis of WT and *Atp7b*^{-/-} livers. (A) Heat map of significantly changed (FDR<0.05 and FC>1.5) genes. (B) Volcano plot visualizing the log₂ FC in gene expression in *Atp7b*^{-/-} mice compared to WT controls. Statistically insignificant (FDR > 0.05) genes with a fold change less than 1.5 are in blue while significant (FDR < 0.05) genes with a fold change of 1.5 are in red.



Supplemental Figure 9. Transcriptomic analysis reveals pathways differentially regulated in *Atp7b*^{-/-} liver. (A) KEGG pathway analysis of significantly changed genes ($F_c > 1.5$, $FDR < 0.05$) from *Atp7b*^{-/-} mouse microarray analysis. NES – network enrichment score. * - $\log_{10}(q\text{-value})$. (B) Pathway analysis of transcription factor binding was performed with the microarray analysis genes ($F_c > 1.5$, $FDR < 0.05$) using the web based EnrichR platform (27141961). Binding sites identified from ChIP-Seq data within (B) up-regulated genes : FOXM1-A, FOXM1_23109430_ChIP-Seq_U2OS_Human; FOXM1 - B, FOXM1_25889361_ChIP-Seq_OE33_AND_U2OS_Human; E2F4_17652178_ChIP-ChIP_JURKAT_Human; AR(NR3C4)_21909140_ChIP-Seq_LNCAP_Human; TRP63_18441228_ChIP-ChIP_KERATINOCYTES_Mouse; LXR(NR1H3)_22158963_ChIP-Seq_LIVER_Mouse; SOX2_27498859_ChIP-Seq_STOMACH_Mouse.



Supplemental Figure 10. GDF15 is increased in *Atp7b*^{-/-} mice fed either chow or Western diet. (A) Hepatic *Gdf15* mRNA expression in chow, ad-lib fed wild-type (WT) and *Atp7b*^{-/-} mice at 3 (3 MO) and 6 (6 MO) months of age. (B) Serum GDF15 concentrations in ad lib-fed 3- and 6-month-old WT and *Atp7b*^{-/-} mice fed chow or Western diet (WD). n=3-6 per group, except for serum GDF15 measurement in 6 MO Chow *Atp7b*^{-/-} mice, **P*<0.05 as determined by Student's t-test for age-matched WT vs. *Atp7b*^{-/-} mice. #*P*<0.05 as determined by 2-way ANOVA between 3-month-old or 6-month-old chow diet-fed WT mice vs 6-month-old Western diet-fed WT mice. Statistical analysis of serum GDF15 within the 6-month-old chow diet-fed cohort was not performed, because n=2 for *Atp7b*^{-/-} mice in that age/diet group.

Supplemental Table 1. Fold change of significantly changed mRNAs in *Atp7b*^{-/-} mice (KO/WT)

Gene Symbol	Fold Change	Log2 Fold Change	P Value	Q Value
2410089E03Rik	63.15	5.98081	0.00000	0.00076
Esco2	62.83	5.97347	0.00040	0.01425
Myom2	57.08	5.83486	0.00000	0.00120
Mt2	52.89	5.72493	0.00057	0.01681
Ddias	32.07	5.00326	0.00000	0.00165
Shcbp1	31.50	4.97732	0.00000	0.00213
Zwilch	24.60	4.62081	0.00004	0.00455
Birc5	24.30	4.60308	0.00006	0.00524
C330027C09Rik	21.75	4.44264	0.00001	0.00279
Ttk	20.51	4.35800	0.00001	0.00279
Mbd1	20.00	4.32186	0.00006	0.00572
Wfdc12	18.55	4.21334	0.00016	0.00944
Ncapg	18.33	4.19611	0.00007	0.00611
Cdca5	18.23	4.18797	0.00000	0.00165
Gria3	17.89	4.16128	0.00032	0.01287
A230058F20Rik	17.30	4.11296	0.00000	0.00120
Fam19a2	17.07	4.09342	0.00001	0.00240
Smoc2	16.89	4.07830	0.00000	0.00033
Ect2	16.01	4.00058	0.00001	0.00224
Mad2l1	15.65	3.96798	0.00000	0.00194
Cdc20	15.51	3.95468	0.00001	0.00249
Mybl1	14.85	3.89221	0.00017	0.00966
Kif20b	14.32	3.84039	0.00029	0.01228
Rad51	14.15	3.82293	0.00132	0.02479
Cep55	13.64	3.77020	0.00000	0.00120
Trip13	12.95	3.69509	0.00023	0.01086
Mis18bp1	12.47	3.63990	0.00001	0.00300
Cenpw	12.42	3.63501	0.00001	0.00227
Smc2	11.97	3.58149	0.00008	0.00664
Sult1e1	11.87	3.56957	0.00597	0.04991
Stap1	11.81	3.56178	0.00197	0.03039
Arhgap11a	11.55	3.52937	0.00005	0.00479
Cdkn1a	11.41	3.51254	0.00004	0.00455
Robo1	10.74	3.42546	0.00027	0.01186
Cenpp	10.72	3.42267	0.00028	0.01205

Pls1	10.72	3.42222	0.00076	0.01872
Spdl1	10.60	3.40533	0.00003	0.00441
Cdk1	10.52	3.39513	0.00001	0.00252
Lrp2	10.46	3.38745	0.00022	0.01074
2700099C18Rik	10.30	3.36473	0.00063	0.01765
Pbk	10.28	3.36157	0.00002	0.00308
Asns	9.96	3.31616	0.00001	0.00301
Cdca8	9.91	3.30939	0.00011	0.00765
Ube2c	9.80	3.29330	0.00000	0.00165
Bub1	9.72	3.28078	0.00211	0.03133
Afp	9.69	3.27643	0.00047	0.01525
BC021614	9.49	3.24702	0.00001	0.00293
Ccdc11	9.21	3.20282	0.00330	0.03782
Got111	9.20	3.20224	0.00033	0.01320
Phlda3	9.09	3.18376	0.00082	0.01963
LOC102635234	8.99	3.16858	0.00348	0.03842
Tacc3	8.92	3.15714	0.00000	0.00135
Cenpq	8.42	3.07311	0.00000	0.00033
Spag5	8.41	3.07224	0.00003	0.00395
Slc35f2	8.24	3.04323	0.00308	0.03680
Calml4	8.07	3.01259	0.00262	0.03426
Sgol2	8.06	3.01152	0.00007	0.00605
Cyp2d12	7.95	2.99183	0.00006	0.00572
Atp2b2	7.88	2.97788	0.00033	0.01318
2900046L07Rik	7.87	2.97635	0.00115	0.02317
Mis18a	7.73	2.95041	0.00001	0.00224
Csf2rb	7.65	2.93567	0.00016	0.00943
Cenpi	7.37	2.88130	0.00004	0.00470
Racgap1	7.24	2.85643	0.00024	0.01113
2700094K13Rik	7.04	2.81572	0.00001	0.00279
Fancb	6.84	2.77325	0.00000	0.00120
Ccdc18	6.80	2.76465	0.00005	0.00496
Exoc4	6.75	2.75508	0.00038	0.01388
Eda2r	6.67	2.73819	0.00099	0.02170
Ska1	6.62	2.72760	0.00001	0.00279
Cib3	6.59	2.71979	0.00004	0.00455
Ifi2712b	6.56	2.71403	0.00036	0.01361
Lin9	6.53	2.70671	0.00000	0.00120
Mcm8	6.43	2.68540	0.00066	0.01780

Smim22	6.19	2.63022	0.00001	0.00217
Gsg2	6.15	2.62171	0.00000	0.00085
Lin54	6.14	2.61853	0.00015	0.00909
Tff3	6.13	2.61484	0.00296	0.03631
Kif11	6.09	2.60527	0.00090	0.02071
Lrp11	6.07	2.60159	0.00010	0.00749
Ndc1	6.07	2.60056	0.00000	0.00053
Ccng1	6.02	2.59096	0.00005	0.00488
Psrc1	5.98	2.58074	0.00241	0.03332
Grk5	5.93	2.56838	0.00034	0.01333
Stil	5.85	2.54947	0.00008	0.00655
Spc25	5.77	2.52854	0.00164	0.02771
Sass6	5.72	2.51676	0.00001	0.00223
Olig1	5.69	2.50829	0.00101	0.02198
Sgol1	5.67	2.50407	0.00043	0.01454
Oip5	5.66	2.50032	0.00076	0.01872
Smc4	5.61	2.48737	0.00002	0.00308
Gdf15	5.58	2.47962	0.00023	0.01081
Brca1	5.52	2.46497	0.00003	0.00389
Plk4	5.52	2.46338	0.00000	0.00120
Nusap1	5.49	2.45666	0.00035	0.01357
Rpp40	5.45	2.44608	0.00017	0.00954
Dbf4	5.43	2.44115	0.00001	0.00249
Malat1	5.42	2.43814	0.00200	0.03051
Slc37a2	5.41	2.43570	0.00001	0.00240
Gpx6	5.40	2.43218	0.00252	0.03380
Kif22	5.38	2.42854	0.00175	0.02857
Kif18a	5.37	2.42492	0.00000	0.00166
Cenpa	5.36	2.42350	0.00000	0.00213
Anln	5.32	2.41200	0.00087	0.02024
Aaas	5.29	2.40334	0.00000	0.00120
Dntt	5.25	2.39268	0.00003	0.00395
Ier5	5.24	2.38923	0.00002	0.00330
Adrb3	5.23	2.38809	0.00002	0.00304
Suv39h1	5.23	2.38759	0.00000	0.00085
Mkl1	5.23	2.38559	0.00260	0.03420
Lipo1	5.20	2.37885	0.00071	0.01827
Cdca3	5.17	2.37047	0.00060	0.01731
Btg2	5.14	2.36233	0.00004	0.00455

Ckap2	5.12	2.35650	0.00158	0.02705
Spc24	5.12	2.35561	0.00000	0.00165
Kifc1	4.94	2.30432	0.00001	0.00227
Ccdc34	4.90	2.29297	0.00018	0.00990
Sulf2	4.76	2.25178	0.00028	0.01206
Lpl	4.73	2.24325	0.00010	0.00745
Fmn2	4.73	2.24115	0.00067	0.01780
1700007K13Rik	4.72	2.23737	0.00049	0.01550
Camk2n2	4.69	2.23044	0.00001	0.00240
Parpbp	4.67	2.22435	0.00022	0.01074
Spink5	4.66	2.21975	0.00022	0.01081
BC022960	4.65	2.21846	0.00035	0.01341
Mtmr7	4.63	2.21073	0.00013	0.00847
Neb	4.63	2.21031	0.00007	0.00610
Slc16a5	4.61	2.20475	0.00010	0.00745
Trp53inp1	4.59	2.19938	0.00017	0.00975
Nek2	4.58	2.19612	0.00001	0.00217
Dis3l2	4.57	2.19344	0.00005	0.00506
Ncapg2	4.57	2.19079	0.00003	0.00400
Ddit4l	4.50	2.17025	0.00171	0.02818
Treh	4.50	2.17010	0.00407	0.04133
Pkhd1	4.49	2.16657	0.00006	0.00572
Gadd45g	4.48	2.16441	0.00352	0.03867
Cd36	4.46	2.15621	0.00180	0.02895
2900009J06Rik	4.41	2.13962	0.00041	0.01431
Mnd1	4.40	2.13902	0.00001	0.00279
Ube2t	4.38	2.12988	0.00005	0.00479
Ccdc77	4.38	2.12941	0.00001	0.00223
Armc8	4.20	2.07160	0.00223	0.03189
Hmnr	4.18	2.06440	0.00244	0.03345
Knstrn	4.16	2.05828	0.00005	0.00506
Top2a	4.15	2.05383	0.00014	0.00883
Plk2	4.14	2.04960	0.00022	0.01074
Ces2e	4.14	2.04930	0.00004	0.00466
Chek2	4.12	2.04335	0.00015	0.00892
Trim68	4.11	2.04079	0.00003	0.00395
Aurka	4.11	2.03997	0.00012	0.00808
Klk1b4	4.11	2.03816	0.00019	0.01020
Klhl13	4.10	2.03515	0.00119	0.02354

Dkk4	4.10	2.03451	0.00304	0.03664
Poc1a	4.08	2.02727	0.00003	0.00395
Rad54b	4.07	2.02622	0.00001	0.00274
Cenpm	4.03	2.01127	0.00032	0.01290
Cdcp1	4.00	2.00012	0.00199	0.03044
Spidr	3.98	1.99365	0.00029	0.01235
Rsph3a	3.98	1.99168	0.00000	0.00120
Sybu	3.96	1.98465	0.00080	0.01932
Ndc80	3.93	1.97284	0.00000	0.00201
Zfp36	3.91	1.96596	0.00466	0.04385
Bub1b	3.90	1.96259	0.00076	0.01872
Mterfd3	3.89	1.96071	0.00138	0.02536
4933438K21Rik	3.87	1.95384	0.00010	0.00731
Tpx2	3.86	1.94938	0.00000	0.00130
Gtse1	3.83	1.93853	0.00005	0.00488
Fam83f	3.83	1.93732	0.00001	0.00301
Aldh1b1	3.82	1.93314	0.00002	0.00321
Fam53b	3.81	1.93012	0.00002	0.00307
McpH1	3.81	1.92939	0.00109	0.02267
A830010M20Rik	3.78	1.91854	0.00127	0.02412
Zak	3.77	1.91573	0.00001	0.00224
C4bp-ps1	3.77	1.91534	0.00000	0.00213
Lrr1	3.76	1.91011	0.00005	0.00488
Ncaph	3.72	1.89610	0.00020	0.01032
Tstd1	3.71	1.89319	0.00004	0.00462
Ocel1	3.70	1.88765	0.00000	0.00120
9130409I23Rik	3.67	1.87674	0.00066	0.01780
Fam72a	3.67	1.87553	0.00000	0.00120
Nuf2	3.63	1.85802	0.00078	0.01911
Ttc39a	3.61	1.85037	0.00335	0.03804
Gngt1	3.60	1.84761	0.00218	0.03170
Dsn1	3.59	1.84543	0.00026	0.01179
Mastl	3.59	1.84257	0.00041	0.01431
Exo1	3.57	1.83437	0.00004	0.00455
Lamb3	3.56	1.83011	0.00043	0.01465
Incenp	3.55	1.82670	0.00013	0.00858
Zfp458	3.54	1.82271	0.00010	0.00725
A530020G20Rik	3.53	1.81982	0.00001	0.00303
Aen	3.52	1.81415	0.00000	0.00120

Aspm	3.49	1.80520	0.00002	0.00326
Snhg11	3.48	1.79994	0.00067	0.01780
Dnaic1	3.48	1.79767	0.00111	0.02293
Tmem237	3.47	1.79490	0.00006	0.00572
Trdmt1	3.46	1.79134	0.00012	0.00795
Hexb	3.44	1.78077	0.00119	0.02354
Acnat2	3.44	1.78053	0.00108	0.02263
Smyd1	3.43	1.77619	0.00037	0.01374
Arsg	3.42	1.77398	0.00020	0.01028
Apaf1	3.38	1.75567	0.00052	0.01585
Tube1	3.37	1.75395	0.00022	0.01074
Haus5	3.35	1.74601	0.00032	0.01301
Cep128	3.35	1.74316	0.00565	0.04847
Ska3	3.34	1.73980	0.00011	0.00765
Tdrkh	3.32	1.73260	0.00004	0.00464
Nqo1	3.32	1.73259	0.00194	0.03027
Tmprss2	3.32	1.72967	0.00299	0.03643
Atp6v0d2	3.28	1.71428	0.00247	0.03355
Atr	3.27	1.70818	0.00326	0.03764
2610028L16Rik	3.26	1.70316	0.00047	0.01518
Agpat9	3.23	1.69115	0.00114	0.02315
Morc4	3.22	1.68857	0.00014	0.00883
Tmem184c	3.19	1.67399	0.00023	0.01093
Polk	3.17	1.66580	0.00003	0.00407
Rbp1	3.17	1.66578	0.00030	0.01244
Endog	3.16	1.66147	0.00000	0.00130
Car2	3.13	1.64830	0.00000	0.00168
2610020H08Rik	3.13	1.64677	0.00004	0.00455
Gm13139	3.13	1.64551	0.00025	0.01135
Mgst3	3.13	1.64547	0.00008	0.00659
9030617O03Rik	3.13	1.64481	0.00008	0.00620
Zranb3	3.12	1.63961	0.00024	0.01123
5033406O09Rik	3.10	1.63016	0.00004	0.00464
Hamp2	3.09	1.62805	0.00360	0.03918
Ercc6l	3.08	1.62324	0.00009	0.00678
S100a10	3.07	1.61721	0.00266	0.03449
Blnk	3.06	1.61124	0.00318	0.03729
Hltf	3.04	1.60602	0.00046	0.01501
Phip	3.04	1.60289	0.00007	0.00610

Depdc1b	3.03	1.60161	0.00075	0.01870
Cyp2g1	3.03	1.60143	0.00341	0.03825
Htati2	3.03	1.59722	0.00001	0.00279
LOC624295	3.00	1.58556	0.00017	0.00975
Nipal1	2.99	1.57938	0.00213	0.03134
Cep192	2.98	1.57708	0.00003	0.00395
Tm6sf2	2.97	1.57284	0.00000	0.00130
Lsm3	2.97	1.57079	0.00003	0.00414
Erc2	2.97	1.56875	0.00049	0.01548
Tert	2.96	1.56488	0.00023	0.01086
Nt5e	2.95	1.55908	0.00046	0.01501
Emp2	2.95	1.55877	0.00248	0.03357
D7Ert715e	2.95	1.55862	0.00156	0.02693
Gtdc1	2.94	1.55360	0.00210	0.03114
Gstm3	2.93	1.55299	0.00102	0.02206
Rad18	2.93	1.55205	0.00397	0.04084
Tmem120a	2.93	1.55112	0.00002	0.00308
Nup133	2.93	1.54985	0.00015	0.00892
Psmb9	2.93	1.54936	0.00006	0.00572
Inadl	2.92	1.54799	0.00020	0.01037
Eppk1	2.92	1.54727	0.00331	0.03786
Ccdc120	2.91	1.54013	0.00034	0.01321
Cdk5rap2	2.88	1.52648	0.00004	0.00476
Gle1	2.87	1.52258	0.00000	0.00147
Cyp4f16	2.85	1.51244	0.00013	0.00860
Mdm2	2.85	1.51176	0.00030	0.01264
Clic5	2.85	1.51164	0.00114	0.02315
Gen1	2.85	1.51128	0.00019	0.01028
Atad2	2.85	1.51087	0.00067	0.01782
Adck4	2.85	1.50922	0.00113	0.02315
Haus6	2.85	1.50900	0.00013	0.00863
Rian	2.84	1.50825	0.00356	0.03887
Espl1	2.84	1.50815	0.00006	0.00521
Ccdc163	2.84	1.50557	0.00012	0.00824
Senp7	2.83	1.50272	0.00069	0.01821
Ctps2	2.83	1.50142	0.00004	0.00455
Lrriq3	2.83	1.50031	0.00000	0.00120
Esr1	2.82	1.49482	0.00315	0.03723
Pxylp1	2.81	1.49152	0.00021	0.01064

Aldh2	2.81	1.49064	0.00019	0.01028
Mkxn1	2.81	1.48810	0.00275	0.03498
Traip	2.80	1.48326	0.00001	0.00297
Cnot7	2.78	1.47702	0.00045	0.01480
Preli2	2.78	1.47636	0.00001	0.00279
Scamp5	2.78	1.47443	0.00001	0.00217
Asf1b	2.77	1.47153	0.00003	0.00400
Atp8b4	2.77	1.47113	0.00456	0.04356
Tmem71	2.77	1.46906	0.00116	0.02332
Tfrc	2.77	1.46855	0.00176	0.02861
Ppl	2.74	1.45319	0.00103	0.02214
Itih5	2.73	1.45015	0.00002	0.00307
Eri2	2.73	1.44921	0.00002	0.00343
Cdca2	2.72	1.44413	0.00093	0.02104
Col5a3	2.70	1.43262	0.00254	0.03382
Ddit4	2.69	1.42960	0.00024	0.01115
Cenpe	2.68	1.42416	0.00201	0.03051
Gca	2.66	1.41166	0.00066	0.01780
Wwtr1	2.65	1.40855	0.00064	0.01778
Nek3	2.64	1.40262	0.00001	0.00249
Il17rb	2.64	1.40049	0.00019	0.01028
Tob2	2.64	1.39914	0.00294	0.03618
Snrnp25	2.63	1.39528	0.00082	0.01963
Kif4	2.63	1.39422	0.00001	0.00224
Hist1h1c	2.63	1.39388	0.00571	0.04881
Zfp101	2.62	1.39056	0.00002	0.00316
Lsm2	2.62	1.38983	0.00000	0.00120
Neat1	2.61	1.38455	0.00098	0.02170
Vrk1	2.61	1.38241	0.00005	0.00488
Sult1b1	2.61	1.38211	0.00075	0.01870
Col12a1	2.61	1.38198	0.00020	0.01037
Mtss1	2.60	1.38015	0.00477	0.04444
Pir	2.60	1.37720	0.00006	0.00546
Ptpdc1	2.60	1.37652	0.00275	0.03498
2810408I11Rik	2.58	1.36954	0.00047	0.01515
Wdpcp	2.58	1.36466	0.00332	0.03789
Fam32a	2.57	1.36261	0.00074	0.01867
G2e3	2.57	1.35924	0.00024	0.01113
Gsta2	2.56	1.35868	0.00022	0.01074

Cenpn	2.56	1.35820	0.00035	0.01357
Mgat5	2.56	1.35517	0.00000	0.00197
Srxn1	2.55	1.35224	0.00069	0.01821
Alg13	2.54	1.34711	0.00002	0.00335
Hr	2.54	1.34594	0.00493	0.04523
Ints10	2.53	1.34097	0.00294	0.03618
Eid1	2.53	1.33737	0.00011	0.00794
5830418K08Rik	2.52	1.33500	0.00005	0.00521
Sema4f	2.52	1.33191	0.00434	0.04260
Tmem43	2.52	1.33074	0.00125	0.02406
Zfp54	2.51	1.32771	0.00019	0.01028
Ablim1	2.51	1.32721	0.00157	0.02701
Fam122b	2.51	1.32509	0.00004	0.00455
Mbl2	2.50	1.31948	0.00017	0.00966
Srbd1	2.49	1.31801	0.00002	0.00320
Thns12	2.49	1.31557	0.00002	0.00307
Figf	2.49	1.31417	0.00050	0.01561
Tctex1d2	2.49	1.31407	0.00238	0.03313
Lrrc40	2.48	1.31322	0.00067	0.01782
Ano10	2.47	1.30656	0.00030	0.01244
Rev1	2.47	1.30642	0.00043	0.01454
Rsrc1	2.46	1.29977	0.00003	0.00414
Cenpl	2.45	1.29524	0.00404	0.04113
Prc1	2.45	1.29512	0.00058	0.01703
Pdgfa	2.45	1.29241	0.00038	0.01396
Smpd3	2.44	1.28977	0.00031	0.01271
4930526I15Rik	2.44	1.28946	0.00114	0.02315
Sgsm1	2.44	1.28582	0.00299	0.03643
Xrcc4	2.43	1.28386	0.00289	0.03599
BC052040	2.43	1.28221	0.00016	0.00928
Aebp2	2.43	1.28210	0.00017	0.00980
Notch1	2.43	1.27918	0.00001	0.00279
Gm2a	2.42	1.27348	0.00008	0.00668
Zfp868	2.42	1.27315	0.00042	0.01445
Plxnb1	2.41	1.26644	0.00031	0.01269
Mmd2	2.40	1.26289	0.00090	0.02071
Nipal3	2.40	1.26217	0.00458	0.04357
Micu2	2.39	1.25902	0.00001	0.00224
Abhd10	2.39	1.25703	0.00015	0.00912

Kif18b	2.39	1.25686	0.00274	0.03498
Zap70	2.39	1.25645	0.00004	0.00462
Rps4l	2.39	1.25570	0.00036	0.01373
Ube2u	2.39	1.25510	0.00042	0.01438
Cenpj	2.38	1.25066	0.00072	0.01827
Sirt5	2.36	1.24067	0.00002	0.00337
Pgd	2.36	1.24028	0.00130	0.02465
Gstm4	2.36	1.23971	0.00137	0.02532
Mettl15	2.36	1.23919	0.00088	0.02044
Kdf1	2.36	1.23852	0.00178	0.02880
Galns	2.35	1.23416	0.00009	0.00705
Zfp667	2.35	1.23392	0.00233	0.03273
2210039B01Rik	2.35	1.23247	0.00023	0.01086
Zfp53	2.35	1.23022	0.00436	0.04268
Tceal8	2.34	1.22920	0.00241	0.03332
Zcchc11	2.34	1.22866	0.00375	0.03999
Psmf1	2.34	1.22656	0.00001	0.00249
Ube2l6	2.34	1.22479	0.00009	0.00696
D030056L22Rik	2.34	1.22437	0.00044	0.01471
Itgb3bp	2.33	1.22294	0.00008	0.00630
Arhgef16	2.33	1.22035	0.00273	0.03493
Slc35c2	2.31	1.20948	0.00134	0.02509
Myef2	2.31	1.20856	0.00040	0.01425
Plk1	2.30	1.20208	0.00222	0.03188
Zfp820	2.30	1.19864	0.00104	0.02216
9230114K14Rik	2.29	1.19832	0.00067	0.01780
Prim2	2.29	1.19683	0.00205	0.03087
2610005L07Rik	2.29	1.19458	0.00006	0.00571
Uaca	2.29	1.19380	0.00065	0.01780
Trappc6a	2.29	1.19299	0.00002	0.00321
Rb1	2.28	1.19190	0.00261	0.03426
Tubb4b	2.28	1.19175	0.00020	0.01037
Fuca2	2.28	1.19072	0.00077	0.01889
Brd9	2.28	1.18720	0.00001	0.00217
Rfc5	2.28	1.18637	0.00151	0.02652
Abcb1a	2.28	1.18630	0.00070	0.01827
Szt2	2.27	1.18361	0.00086	0.02018
Exosc8	2.26	1.17658	0.00000	0.00165
Osbpl3	2.26	1.17564	0.00294	0.03618

Pdk4	2.26	1.17377	0.00281	0.03545
Wfdc15b	2.25	1.16865	0.00485	0.04474
Pdss1	2.25	1.16700	0.00003	0.00395
Amot	2.24	1.16670	0.00029	0.01244
Anxa5	2.24	1.16549	0.00182	0.02920
Cenpt	2.24	1.16508	0.00046	0.01501
D5Erttd579e	2.24	1.16373	0.00378	0.04008
Nat1	2.24	1.16180	0.00245	0.03348
Phf20l1	2.23	1.15986	0.00138	0.02536
Asap1	2.23	1.15883	0.00091	0.02071
Ccdc141	2.23	1.15828	0.00179	0.02889
Myo5b	2.23	1.15632	0.00185	0.02955
Phkb	2.23	1.15585	0.00005	0.00516
Cmss1	2.22	1.15274	0.00045	0.01501
Alpl	2.22	1.15059	0.00050	0.01562
Etl4	2.22	1.15039	0.00036	0.01372
Gja1	2.21	1.14657	0.00540	0.04733
Gstcd	2.21	1.14598	0.00004	0.00466
Zfp182	2.21	1.14591	0.00555	0.04796
Prpf38a	2.21	1.14322	0.00093	0.02105
Zgrf1	2.20	1.13870	0.00097	0.02155
Fam213a	2.20	1.13802	0.00314	0.03720
Zfp69	2.20	1.13715	0.00468	0.04398
Ank3	2.20	1.13546	0.00528	0.04670
Ppp2r3d	2.20	1.13512	0.00146	0.02595
Rasgef1b	2.20	1.13426	0.00091	0.02071
Adora1	2.19	1.13224	0.00587	0.04955
Slc2a1	2.19	1.13115	0.00063	0.01765
Zmat3	2.19	1.12968	0.00000	0.00088
Chid1	2.19	1.12963	0.00067	0.01780
Abhd4	2.19	1.12809	0.00390	0.04057
Slc22a18	2.18	1.12349	0.00132	0.02477
Ofd1	2.18	1.12227	0.00101	0.02197
1700048O20Rik	2.18	1.12208	0.00014	0.00883
I7Rn6	2.17	1.12025	0.00541	0.04739
Wnt5b	2.17	1.11549	0.00347	0.03842
Entpd2	2.17	1.11493	0.00149	0.02636
Mtap	2.16	1.11249	0.00001	0.00223
Entpd5	2.16	1.11170	0.00000	0.00165

Srcrb4d	2.16	1.11060	0.00018	0.01011
Pawr	2.15	1.10676	0.00273	0.03493
Eif2d	2.15	1.10587	0.00000	0.00015
Lclat1	2.15	1.10546	0.00030	0.01264
Clip4	2.15	1.10464	0.00176	0.02859
Capn8	2.15	1.10356	0.00266	0.03449
2200002D01Rik	2.15	1.10222	0.00142	0.02577
Ccm2l	2.15	1.10199	0.00550	0.04777
Fcor	2.14	1.10042	0.00170	0.02810
Lmo7	2.14	1.10033	0.00040	0.01425
Cc2d2a	2.14	1.09999	0.00037	0.01388
Mknk2	2.14	1.09987	0.00002	0.00373
Mtpn	2.14	1.09893	0.00309	0.03682
Tob1	2.14	1.09768	0.00343	0.03830
Myom3	2.14	1.09741	0.00374	0.03998
Kifc5b	2.14	1.09705	0.00363	0.03935
Tmem194	2.14	1.09589	0.00039	0.01411
Mmp15	2.14	1.09571	0.00078	0.01912
Me1	2.14	1.09474	0.00381	0.04018
Ccdc122	2.13	1.08747	0.00027	0.01179
A530083I20Rik	2.12	1.08412	0.00248	0.03355
Meis1	2.11	1.08061	0.00066	0.01780
Twf2	2.11	1.08023	0.00001	0.00279
Gm10336	2.11	1.07954	0.00041	0.01431
Catsperd	2.11	1.07930	0.00102	0.02206
Dock7	2.11	1.07818	0.00108	0.02263
Ocln	2.11	1.07791	0.00042	0.01438
Zfp941	2.11	1.07565	0.00238	0.03313
Gyg	2.11	1.07492	0.00014	0.00888
D630024D03Rik	2.10	1.07108	0.00010	0.00727
Rhno1	2.10	1.06946	0.00001	0.00224
Rps6kc1	2.10	1.06723	0.00162	0.02756
Hspa4l	2.09	1.06659	0.00222	0.03188
Tssc1	2.09	1.06559	0.00290	0.03602
Tinf2	2.09	1.06458	0.00020	0.01036
Tgfb2	2.09	1.06029	0.00383	0.04029
Zfp81	2.08	1.05941	0.00164	0.02776
Mapre2	2.08	1.05799	0.00151	0.02652
Asic5	2.08	1.05722	0.00007	0.00585

Anapc4	2.08	1.05568	0.00007	0.00610
Avpi1	2.08	1.05475	0.00012	0.00824
E2f2	2.08	1.05387	0.00088	0.02044
Vrk2	2.08	1.05382	0.00033	0.01306
Rbmx2	2.08	1.05324	0.00001	0.00279
Ddx1	2.07	1.04932	0.00002	0.00321
3110009E18Rik	2.07	1.04825	0.00331	0.03789
Krt8	2.07	1.04697	0.00033	0.01306
Cebpb	2.07	1.04632	0.00418	0.04173
Lyp1a1	2.06	1.04587	0.00001	0.00279
Ccdc68	2.06	1.04521	0.00259	0.03420
Cblc	2.06	1.04458	0.00319	0.03729
Aptx	2.06	1.04280	0.00110	0.02274
Clhc1	2.06	1.04267	0.00051	0.01585
Bbs4	2.06	1.04046	0.00010	0.00745
Blm	2.05	1.03812	0.00093	0.02106
AK153988	2.05	1.03707	0.00122	0.02386
Rdh16	2.05	1.03554	0.00173	0.02831
Ugdh	2.05	1.03403	0.00012	0.00808
Fam118a	2.05	1.03244	0.00116	0.02332
I133	2.04	1.03043	0.00109	0.02268
Scd2	2.04	1.03042	0.00459	0.04363
Parp16	2.04	1.03010	0.00077	0.01880
Ces1g	2.04	1.02942	0.00353	0.03868
Gnat2	2.04	1.02572	0.00201	0.03051
Cdkl2	2.03	1.02397	0.00029	0.01228
Syne3	2.03	1.02058	0.00193	0.03025
Tasp1	2.03	1.01905	0.00185	0.02951
Ccl9	2.02	1.01710	0.00142	0.02577
Uvrag	2.02	1.01673	0.00054	0.01631
Commd3	2.02	1.01395	0.00276	0.03505
Mkrn2os	2.02	1.01153	0.00103	0.02211
Kif24	2.02	1.01092	0.00265	0.03449
Ephx1	2.01	1.01022	0.00005	0.00488
Zfp438	2.01	1.00706	0.00222	0.03188
Slc3a1	2.01	1.00501	0.00124	0.02397
Fanci	2.00	1.00086	0.00059	0.01718
Ppap2a	2.00	0.99992	0.00030	0.01264
Nudcd2	2.00	0.99806	0.00015	0.00909

Cast	2.00	0.99718	0.00114	0.02315
Dpp7	2.00	0.99696	0.00003	0.00403
Lrig3	1.99	0.99551	0.00507	0.04581
Lrp1	1.99	0.99470	0.00381	0.04018
Myo1b	1.99	0.98952	0.00070	0.01822
Slc23a1	1.98	0.98861	0.00106	0.02239
AA408650	1.98	0.98835	0.00201	0.03051
Tmsb10	1.98	0.98732	0.00021	0.01048
Slc1a4	1.98	0.98651	0.00551	0.04777
Camkmt	1.98	0.98556	0.00089	0.02054
Hpgd	1.98	0.98503	0.00178	0.02872
Cdkn3	1.97	0.97920	0.00570	0.04878
Itfg1	1.97	0.97916	0.00126	0.02411
Pnpla5	1.97	0.97881	0.00001	0.00279
Rnd2	1.97	0.97744	0.00016	0.00938
Erc5	1.96	0.97211	0.00016	0.00920
LOC75771	1.96	0.96916	0.00039	0.01408
Spon2	1.96	0.96762	0.00470	0.04403
Bche	1.95	0.96608	0.00007	0.00599
Tpgs2	1.95	0.96499	0.00231	0.03259
Asah2	1.95	0.96390	0.00004	0.00465
Rnf141	1.95	0.96108	0.00003	0.00395
Vat1	1.95	0.95991	0.00018	0.00990
2210016H18Rik	1.94	0.95741	0.00224	0.03193
Cep72	1.94	0.95684	0.00079	0.01918
C80998	1.94	0.95555	0.00047	0.01520
Ctbs	1.94	0.95362	0.00049	0.01553
Slc22a4	1.93	0.94992	0.00568	0.04862
D8Erd51e	1.93	0.94897	0.00127	0.02421
Bbip1	1.93	0.94889	0.00075	0.01870
Zfp518a	1.93	0.94865	0.00075	0.01870
Med30	1.93	0.94857	0.00063	0.01765
4930509E16Rik	1.93	0.94698	0.00155	0.02678
Adamts9	1.93	0.94677	0.00307	0.03673
Aldh1a7	1.93	0.94576	0.00000	0.00120
Tstd3	1.93	0.94551	0.00020	0.01037
Pvt1	1.93	0.94495	0.00057	0.01694
Omd	1.93	0.94488	0.00026	0.01179
Mvp	1.92	0.94435	0.00124	0.02404

Pld6	1.92	0.94344	0.00166	0.02791
Spns2	1.92	0.94131	0.00126	0.02411
4930558J18Rik	1.92	0.94130	0.00007	0.00610
Aim1	1.92	0.94108	0.00104	0.02217
Slc35e3	1.92	0.94099	0.00028	0.01215
Rttn	1.92	0.93824	0.00002	0.00343
Dzip3	1.91	0.93606	0.00002	0.00359
Utp23	1.91	0.93546	0.00019	0.01028
Ehd1	1.91	0.93434	0.00161	0.02751
Eme1	1.91	0.93404	0.00151	0.02652
Arhgap5	1.91	0.93367	0.00444	0.04297
Zfp472	1.91	0.93333	0.00167	0.02795
Myh14	1.91	0.93326	0.00227	0.03225
Tox	1.91	0.93047	0.00237	0.03306
Rangap1	1.91	0.93020	0.00013	0.00833
Det1	1.90	0.92624	0.00369	0.03961
Anxa7	1.90	0.92492	0.00030	0.01244
Zc4h2	1.90	0.92405	0.00022	0.01074
Acad9	1.90	0.92301	0.00048	0.01530
2810428I15Rik	1.89	0.91952	0.00001	0.00279
6030400A10Rik	1.89	0.91918	0.00317	0.03723
Dcaf4	1.89	0.91893	0.00114	0.02315
Elovl1	1.89	0.91863	0.00251	0.03369
Rab3gap2	1.89	0.91797	0.00330	0.03782
Gal3st1	1.89	0.91720	0.00334	0.03802
Emc9	1.89	0.91678	0.00116	0.02332
Galnt10	1.89	0.91502	0.00455	0.04352
Tgm2	1.89	0.91460	0.00004	0.00464
Tbck	1.88	0.91422	0.00021	0.01041
Sdc1	1.88	0.91264	0.00168	0.02798
Vtcn1	1.88	0.91082	0.00007	0.00593
Marveld2	1.88	0.91063	0.00020	0.01037
Aprt	1.88	0.90822	0.00000	0.00213
Pde7a	1.88	0.90814	0.00006	0.00544
Xrcc1	1.87	0.90638	0.00011	0.00770
Zfp958	1.87	0.90444	0.00352	0.03863
Camsap3	1.87	0.90419	0.00116	0.02332
5430416B10Rik	1.87	0.90198	0.00319	0.03729
Hexa	1.87	0.90094	0.00057	0.01694

Tpk1	1.87	0.90019	0.00060	0.01725
Golt1a	1.87	0.90017	0.00055	0.01652
Fat1	1.86	0.89827	0.00251	0.03368
S1pr3	1.86	0.89822	0.00339	0.03812
Cks2	1.86	0.89764	0.00001	0.00272
Carf	1.86	0.89659	0.00049	0.01550
5430439M09Rik	1.86	0.89570	0.00018	0.01000
Enc1	1.86	0.89536	0.00451	0.04328
Rpap3	1.86	0.89213	0.00071	0.01827
Agxt2	1.85	0.89134	0.00137	0.02532
Bcdin3d	1.85	0.88803	0.00001	0.00249
Pfkfb2	1.85	0.88678	0.00259	0.03420
C130051F05Rik	1.85	0.88563	0.00211	0.03132
Slc26a6	1.85	0.88523	0.00052	0.01585
Bax	1.85	0.88520	0.00009	0.00696
Ptk2b	1.85	0.88470	0.00023	0.01086
Nup37	1.84	0.88286	0.00020	0.01028
Nsl1	1.84	0.88268	0.00110	0.02274
Coq7	1.84	0.88239	0.00003	0.00389
Ptpk	1.84	0.88011	0.00293	0.03618
AI314180	1.84	0.87781	0.00005	0.00488
Zfp78	1.84	0.87772	0.00186	0.02961
Mgmt	1.84	0.87659	0.00264	0.03449
Tfcp2l1	1.84	0.87582	0.00338	0.03812
Xpo1	1.83	0.87535	0.00001	0.00279
Gstm7	1.83	0.87500	0.00064	0.01765
Mpzi3	1.83	0.87404	0.00007	0.00585
Ubiad1	1.83	0.87339	0.00022	0.01074
Impact	1.83	0.87254	0.00146	0.02606
Arhgap44	1.83	0.87228	0.00261	0.03426
Trim37	1.83	0.87100	0.00330	0.03782
Cep83	1.83	0.87011	0.00057	0.01683
Clint1	1.83	0.86866	0.00001	0.00279
Erc3	1.83	0.86801	0.00108	0.02263
Nap1l1	1.82	0.86736	0.00007	0.00610
Sesn2	1.82	0.86589	0.00212	0.03133
1700034P13Rik	1.82	0.86313	0.00201	0.03051
Map4	1.82	0.86292	0.00109	0.02271
Hspbap1	1.82	0.86244	0.00141	0.02577

1500011K16Rik	1.82	0.86160	0.00005	0.00488
Mettl4	1.82	0.86053	0.00353	0.03868
Fkbp11	1.82	0.86052	0.00300	0.03650
Rad51ap1	1.81	0.85914	0.00551	0.04777
Eri1	1.81	0.85532	0.00002	0.00330
Bora	1.81	0.85390	0.00126	0.02412
6820431F20Rik	1.81	0.85267	0.00050	0.01569
Rfescd	1.81	0.85230	0.00025	0.01143
Dcxr	1.80	0.85197	0.00044	0.01471
Atp9a	1.80	0.85183	0.00011	0.00772
Mrpl33	1.80	0.85046	0.00170	0.02808
Slc39a14	1.80	0.84807	0.00331	0.03786
Wisp1	1.80	0.84721	0.00083	0.01988
Ddx59	1.80	0.84630	0.00354	0.03875
Hmgb2	1.80	0.84627	0.00127	0.02412
Atxn10	1.80	0.84485	0.00014	0.00863
Ap1m1	1.79	0.84337	0.00245	0.03348
LOC101056118	1.79	0.84318	0.00071	0.01827
Rarb	1.79	0.84307	0.00438	0.04274
Clec16a	1.79	0.84047	0.00014	0.00863
Aasdh	1.79	0.83812	0.00023	0.01086
Slc16a7	1.79	0.83778	0.00163	0.02758
Lasp1	1.78	0.83591	0.00005	0.00488
Tnfsf10	1.78	0.83491	0.00342	0.03828
Rdh5	1.78	0.83010	0.00061	0.01732
9130002K18Rik	1.78	0.82994	0.00560	0.04826
Exd1	1.78	0.82954	0.00277	0.03513
Mtx3	1.77	0.82719	0.00120	0.02361
E130110O22Rik	1.77	0.82654	0.00131	0.02466
Megf9	1.77	0.82608	0.00469	0.04399
Kidins220	1.77	0.82606	0.00059	0.01713
Cep120	1.77	0.82551	0.00036	0.01369
Mrpl15	1.77	0.82468	0.00020	0.01040
Slc50a1	1.77	0.82414	0.00041	0.01425
1810022K09Rik	1.77	0.82144	0.00592	0.04979
Arhgef39	1.76	0.81916	0.00131	0.02466
Dck	1.76	0.81811	0.00167	0.02795
Tgfb1	1.76	0.81677	0.00329	0.03775
Fam129c	1.76	0.81612	0.00178	0.02880

Cyp4v3	1.76	0.81576	0.00453	0.04337
Gfm1	1.76	0.81479	0.00333	0.03800
Cpeb3	1.75	0.81117	0.00299	0.03643
Ap3m1	1.75	0.81018	0.00082	0.01962
Isoc1	1.75	0.81002	0.00009	0.00713
Dpysl2	1.75	0.80912	0.00000	0.00128
Reep4	1.75	0.80901	0.00171	0.02817
Dlc1	1.75	0.80901	0.00423	0.04211
Apoc2	1.75	0.80887	0.00110	0.02275
Chmp2b	1.75	0.80691	0.00547	0.04760
Ssh1	1.75	0.80658	0.00106	0.02234
Phka2	1.75	0.80656	0.00132	0.02479
Gsdmd	1.75	0.80652	0.00017	0.00954
Sf3b5	1.75	0.80582	0.00002	0.00321
Mad2l1bp	1.75	0.80521	0.00352	0.03861
Cth	1.75	0.80483	0.00008	0.00655
Cse1l	1.74	0.80305	0.00009	0.00668
Cdk17	1.74	0.80296	0.00450	0.04323
Aox1	1.74	0.80233	0.00022	0.01074
Tmem219	1.74	0.79829	0.00174	0.02852
Dqx1	1.74	0.79811	0.00275	0.03498
4930427A07Rik	1.74	0.79710	0.00316	0.03723
Arhgap26	1.74	0.79693	0.00015	0.00906
BC030867	1.74	0.79645	0.00099	0.02173
Lym2	1.74	0.79626	0.00090	0.02071
Pole	1.74	0.79518	0.00286	0.03589
Amy1	1.73	0.79485	0.00186	0.02961
Man2b2	1.73	0.79465	0.00047	0.01518
Mageh1	1.73	0.79456	0.00336	0.03804
Rnaseh2b	1.73	0.79410	0.00019	0.01028
LOC102640387	1.73	0.79388	0.00223	0.03189
Snx10	1.73	0.79318	0.00261	0.03426
Chchd6	1.73	0.79209	0.00475	0.04431
1810010H24Rik	1.73	0.79167	0.00064	0.01778
Fbxo36	1.73	0.79142	0.00030	0.01244
Thoc1	1.73	0.79100	0.00470	0.04403
Igfbp5	1.73	0.78980	0.00388	0.04046
Nsun3	1.73	0.78873	0.00020	0.01037
Cables1	1.73	0.78681	0.00430	0.04244

Nhp2	1.72	0.78635	0.00090	0.02071
Mre11a	1.72	0.78609	0.00003	0.00407
Wwp2	1.72	0.78553	0.00427	0.04230
Mb21d2	1.72	0.78463	0.00381	0.04018
Zfand1	1.72	0.78348	0.00100	0.02179
Hn1	1.72	0.78279	0.00221	0.03188
Tmem53	1.72	0.78268	0.00155	0.02682
Slc30a1	1.72	0.78181	0.00321	0.03738
Poll	1.72	0.78105	0.00062	0.01742
Tap1	1.72	0.78075	0.00295	0.03623
Smim8	1.72	0.77998	0.00004	0.00455
Enpp3	1.72	0.77976	0.00024	0.01113
Dclre1a	1.71	0.77766	0.00039	0.01404
Invs	1.71	0.77686	0.00254	0.03382
Dhcr24	1.71	0.77682	0.00010	0.00740
Cdc14a	1.71	0.77653	0.00197	0.03035
Slc36a1	1.71	0.77647	0.00189	0.02984
Gchfr	1.71	0.77584	0.00031	0.01273
Ift172	1.71	0.77561	0.00015	0.00899
Cyp39a1	1.71	0.77517	0.00540	0.04733
Comt	1.71	0.77500	0.00021	0.01046
Chd1l	1.71	0.77450	0.00096	0.02144
Dbndd2	1.71	0.77356	0.00013	0.00835
Ggt6	1.71	0.77283	0.00103	0.02211
Myh10	1.71	0.77082	0.00433	0.04255
8030447M02Rik	1.71	0.77033	0.00151	0.02652
Trio	1.70	0.76901	0.00108	0.02263
Arhgef5	1.70	0.76886	0.00056	0.01665
Tpm1	1.70	0.76872	0.00019	0.01028
Nmi	1.70	0.76764	0.00242	0.03337
Slc25a10	1.70	0.76755	0.00104	0.02221
Kctd9	1.70	0.76705	0.00001	0.00279
Krt18	1.70	0.76669	0.00188	0.02974
Sike1	1.70	0.76656	0.00085	0.01998
Coa6	1.70	0.76604	0.00169	0.02808
Exoc3	1.70	0.76545	0.00003	0.00429
Exosc9	1.70	0.76449	0.00001	0.00274
Dhx35	1.70	0.76413	0.00320	0.03738
Zswim7	1.70	0.76301	0.00066	0.01780

Ptgr1	1.70	0.76180	0.00307	0.03677
Tfpi2	1.69	0.76106	0.00093	0.02105
Psm7	1.69	0.75986	0.00095	0.02132
Xrcc5	1.69	0.75982	0.00071	0.01827
Mrpl13	1.69	0.75884	0.00226	0.03221
Rcbtb2	1.69	0.75712	0.00301	0.03650
Tspan7	1.69	0.75499	0.00082	0.01971
Dnaaf2	1.69	0.75424	0.00000	0.00213
Atf7ip	1.69	0.75291	0.00071	0.01827
Trim12a	1.68	0.75269	0.00514	0.04615
Agfg1	1.68	0.75258	0.00156	0.02688
Ppfbp2	1.68	0.75242	0.00145	0.02590
Drc1	1.68	0.75128	0.00413	0.04165
Plp1	1.68	0.75107	0.00208	0.03112
Rcan1	1.68	0.75083	0.00462	0.04372
Cda	1.68	0.75000	0.00111	0.02282
B230118H07Rik	1.68	0.74909	0.00009	0.00696
Atl1	1.68	0.74863	0.00083	0.01972
9130011E15Rik	1.68	0.74851	0.00011	0.00772
Vps36	1.68	0.74764	0.00004	0.00472
Ttc38	1.68	0.74650	0.00007	0.00610
Ccdc158	1.68	0.74617	0.00235	0.03287
Fam184b	1.68	0.74576	0.00218	0.03171
BC026585	1.68	0.74575	0.00030	0.01259
Psm1	1.68	0.74438	0.00056	0.01665
Skiv2l2	1.67	0.74407	0.00079	0.01915
Aspa	1.67	0.74241	0.00069	0.01821
Alg6	1.67	0.74176	0.00222	0.03188
Heatr1	1.67	0.74129	0.00016	0.00928
Rwdd2b	1.67	0.74052	0.00071	0.01827
Parp4	1.67	0.74045	0.00066	0.01780
Blvrb	1.67	0.74002	0.00505	0.04573
Lmbr1	1.67	0.73747	0.00044	0.01471
Smarce1	1.67	0.73559	0.00014	0.00888
Slc38a9	1.66	0.73517	0.00310	0.03689
Ghdc	1.66	0.73299	0.00004	0.00455
Nicn1	1.66	0.73225	0.00005	0.00488
Trmt10a	1.66	0.73143	0.00065	0.01780
Nudcd3	1.66	0.73100	0.00063	0.01754

Mas1	1.66	0.73074	0.00084	0.01989
Rtel1	1.66	0.73004	0.00390	0.04056
Ces2g	1.66	0.72990	0.00152	0.02652
4933404I11Rik	1.66	0.72946	0.00199	0.03044
Prnp	1.66	0.72900	0.00048	0.01546
Polr3gl	1.66	0.72772	0.00576	0.04903
BC003331	1.66	0.72704	0.00158	0.02710
Cul3	1.65	0.72679	0.00317	0.03723
Mdh2	1.65	0.72667	0.00104	0.02217
Ran	1.65	0.72659	0.00011	0.00749
Chchd5	1.65	0.72658	0.00194	0.03025
Klhdc2	1.65	0.72383	0.00177	0.02870
Tmem177	1.65	0.72381	0.00172	0.02829
Plac8	1.65	0.72361	0.00598	0.04996
Psmc4	1.65	0.72328	0.00384	0.04031
Acyp1	1.65	0.72312	0.00587	0.04955
Cwc27	1.65	0.72207	0.00124	0.02399
Ints1	1.65	0.72176	0.00050	0.01562
Mecr	1.65	0.72130	0.00565	0.04847
Rad23a	1.65	0.72062	0.00076	0.01872
Mllt10	1.65	0.71915	0.00365	0.03945
A930013F10Rik	1.65	0.71852	0.00513	0.04612
AU041133	1.65	0.71826	0.00058	0.01708
Ubxn4	1.64	0.71730	0.00294	0.03618
Tmx3	1.64	0.71693	0.00007	0.00585
Zfp473	1.64	0.71663	0.00220	0.03185
Fam160a2	1.64	0.71556	0.00570	0.04877
4732468M13Rik	1.64	0.71548	0.00002	0.00321
Trp53bp1	1.64	0.71523	0.00119	0.02354
Dhdds	1.64	0.71413	0.00120	0.02374
Metap1d	1.64	0.71381	0.00116	0.02332
Gmcl1	1.64	0.71368	0.00188	0.02974
Braf	1.64	0.71252	0.00236	0.03303
Cenpo	1.64	0.71234	0.00084	0.01991
Maged2	1.64	0.71072	0.00038	0.01396
Cry2	1.63	0.70864	0.00068	0.01792
Bloc1s5	1.63	0.70849	0.00004	0.00455
Hnrnpc	1.63	0.70838	0.00470	0.04402
Tmem175	1.63	0.70797	0.00081	0.01941

Slc9a8	1.63	0.70784	0.00206	0.03097
Adh7	1.63	0.70655	0.00326	0.03758
Rtkn	1.63	0.70594	0.00325	0.03752
Dars2	1.63	0.70428	0.00019	0.01028
Med4	1.63	0.70338	0.00135	0.02518
Eif2s2	1.63	0.70313	0.00039	0.01408
Lrwd1	1.63	0.70240	0.00198	0.03042
Nedd1	1.63	0.70173	0.00277	0.03513
Ermp1	1.63	0.70163	0.00022	0.01074
Fam172a	1.63	0.70116	0.00243	0.03340
Mansc1	1.62	0.69839	0.00147	0.02607
Sys1	1.62	0.69822	0.00027	0.01179
Them7	1.62	0.69573	0.00099	0.02174
Rpp30	1.62	0.69538	0.00085	0.02008
Exoc6	1.62	0.69401	0.00061	0.01732
Psmg4	1.62	0.69157	0.00265	0.03449
Clstn3	1.61	0.69139	0.00094	0.02126
Gramd1c	1.61	0.69084	0.00030	0.01257
5031425E22Rik	1.61	0.69044	0.00110	0.02278
Sorbs1	1.61	0.68974	0.00235	0.03287
Thnsl1	1.61	0.68926	0.00067	0.01780
Etnk2	1.61	0.68824	0.00572	0.04886
Ptpn4	1.61	0.68823	0.00015	0.00909
Ttll12	1.61	0.68610	0.00018	0.00983
Herpud2	1.61	0.68450	0.00373	0.03995
Galm	1.61	0.68440	0.00153	0.02659
A530079E22Rik	1.61	0.68371	0.00273	0.03493
Vps25	1.61	0.68335	0.00088	0.02040
Plgrkt	1.61	0.68304	0.00597	0.04992
Camk2g	1.61	0.68298	0.00080	0.01921
Dhrs7b	1.60	0.68208	0.00071	0.01827
Taf1d	1.60	0.68072	0.00316	0.03723
Ly6f	1.60	0.68067	0.00418	0.04173
Plaa	1.60	0.67924	0.00058	0.01708
Nostrin	1.60	0.67906	0.00324	0.03749
C1d	1.60	0.67849	0.00563	0.04842
Alcam	1.60	0.67840	0.00439	0.04279
Mat1a	1.60	0.67806	0.00039	0.01411
Zfp788	1.60	0.67780	0.00056	0.01680

Pkn3	1.60	0.67666	0.00228	0.03231
Prps2	1.60	0.67656	0.00024	0.01116
Tatdn1	1.59	0.67159	0.00197	0.03035
Hdac8	1.59	0.67150	0.00281	0.03545
4933426M11Rik	1.59	0.67148	0.00303	0.03663
Fbxo6	1.59	0.67059	0.00103	0.02211
Myh9	1.59	0.66918	0.00054	0.01632
Parp12	1.59	0.66896	0.00302	0.03656
Zfp775	1.59	0.66838	0.00378	0.04008
Dnajb12	1.59	0.66745	0.00347	0.03842
Tnfaip1	1.59	0.66732	0.00006	0.00547
Nudt16	1.59	0.66663	0.00559	0.04816
Jund	1.59	0.66660	0.00550	0.04776
Col15a1	1.59	0.66628	0.00307	0.03677
Cttn	1.59	0.66528	0.00242	0.03337
Rapgef6	1.59	0.66513	0.00239	0.03319
Mpzl2	1.59	0.66498	0.00108	0.02263
Tbrg1	1.58	0.66419	0.00070	0.01827
Mmp19	1.58	0.66357	0.00365	0.03945
Pptc7	1.58	0.66287	0.00033	0.01309
Tbc1d32	1.58	0.66220	0.00515	0.04623
Tnrc6a	1.58	0.66142	0.00074	0.01867
Cdc25c	1.58	0.66098	0.00094	0.02126
Ube2v2	1.58	0.66090	0.00313	0.03712
Dusp19	1.58	0.66089	0.00218	0.03167
G730007D18Rik	1.58	0.66082	0.00517	0.04629
Tmem62	1.58	0.66069	0.00164	0.02771
Lcp1	1.58	0.66054	0.00463	0.04378
Gmnn	1.58	0.66049	0.00037	0.01374
Mettl22	1.58	0.65937	0.00452	0.04331
Cpm	1.58	0.65912	0.00283	0.03563
Gtf2h2	1.58	0.65905	0.00067	0.01780
Emc1	1.58	0.65847	0.00057	0.01683
Alg14	1.58	0.65760	0.00411	0.04146
Ttc8	1.58	0.65693	0.00041	0.01431
Fkbp9	1.58	0.65650	0.00096	0.02144
Lag3	1.58	0.65649	0.00202	0.03051
Kpna2	1.58	0.65592	0.00012	0.00795
Ccdc71l	1.58	0.65582	0.00009	0.00696

Gstm5	1.57	0.65342	0.00039	0.01402
Fancl	1.57	0.65225	0.00218	0.03168
Dap3	1.57	0.65207	0.00013	0.00830
Nrd1	1.57	0.65146	0.00464	0.04378
March7	1.57	0.65022	0.00450	0.04325
Slc39a11	1.57	0.65019	0.00023	0.01081
Arl3	1.57	0.64972	0.00061	0.01732
Chfr	1.57	0.64912	0.00322	0.03744
H2afz	1.57	0.64819	0.00228	0.03231
Srr	1.57	0.64749	0.00157	0.02696
Ppp5c	1.57	0.64726	0.00007	0.00585
Rabgap1	1.56	0.64597	0.00107	0.02258
Orc3	1.56	0.64574	0.00119	0.02354
Fam126a	1.56	0.64450	0.00244	0.03345
Thyn1	1.56	0.64378	0.00511	0.04600
Cyb5r4	1.56	0.64324	0.00001	0.00279
Txn2	1.56	0.64281	0.00012	0.00808
Acsm5	1.56	0.64273	0.00598	0.04993
Jkamp	1.56	0.64218	0.00532	0.04691
Dclre1b	1.56	0.64193	0.00462	0.04372
Haus1	1.56	0.64178	0.00126	0.02412
Coq3	1.56	0.64037	0.00458	0.04357
Nup35	1.56	0.64014	0.00445	0.04298
Enox2	1.56	0.63972	0.00250	0.03365
Gpn2	1.56	0.63958	0.00084	0.01994
Aplf	1.56	0.63940	0.00032	0.01286
Gemin8	1.56	0.63929	0.00369	0.03961
Tnip1	1.56	0.63782	0.00138	0.02536
Jakmip3	1.56	0.63711	0.00247	0.03355
Cux1	1.55	0.63611	0.00282	0.03553
Eny2	1.55	0.63590	0.00464	0.04382
Gm15234	1.55	0.63570	0.00239	0.03320
Gmfb	1.55	0.63515	0.00588	0.04960
Naf1	1.55	0.63455	0.00182	0.02920
Igf2r	1.55	0.63431	0.00072	0.01830
Tex30	1.55	0.63404	0.00072	0.01830
Hfe2	1.55	0.63393	0.00249	0.03359
Fundc2	1.55	0.63383	0.00393	0.04073
3110040N11Rik	1.55	0.63355	0.00188	0.02974

Pold4	1.55	0.63353	0.00065	0.01780
Atp5s	1.55	0.63349	0.00450	0.04323
Hcfc1r1	1.55	0.63164	0.00010	0.00749
Arap2	1.55	0.63055	0.00189	0.02987
Mob3b	1.55	0.63036	0.00351	0.03859
Dgat1	1.55	0.63032	0.00058	0.01708
Nsmce1	1.55	0.63004	0.00066	0.01780
Scaf11	1.55	0.62978	0.00248	0.03357
Mrps28	1.55	0.62918	0.00020	0.01037
Sf3b1	1.55	0.62812	0.00034	0.01334
2610002J02Rik	1.55	0.62782	0.00066	0.01780
Sigirr	1.54	0.62735	0.00309	0.03680
Tbce	1.54	0.62658	0.00194	0.03025
B130040O20Rik	1.54	0.62562	0.00307	0.03673
Wac	1.54	0.62468	0.00379	0.04011
Oxnad1	1.54	0.62409	0.00163	0.02758
Suv39h2	1.54	0.62387	0.00117	0.02341
Huwe1	1.54	0.62284	0.00020	0.01037
Lmna	1.54	0.62202	0.00273	0.03493
Zfp64	1.54	0.62123	0.00498	0.04545
Nubp1	1.54	0.62123	0.00006	0.00532
Slc6a8	1.54	0.62003	0.00292	0.03609
Rapgef2	1.53	0.61758	0.00270	0.03481
H2afv	1.53	0.61605	0.00155	0.02678
A130004G11Rik	1.53	0.61586	0.00111	0.02292
Slc44a3	1.53	0.61497	0.00489	0.04501
Psen2	1.53	0.61474	0.00112	0.02293
Cbwd1	1.53	0.61442	0.00165	0.02790
Grina	1.53	0.61255	0.00332	0.03789
Gins3	1.53	0.61219	0.00162	0.02756
Anxa6	1.53	0.61047	0.00113	0.02315
2810414N06Rik	1.53	0.60977	0.00101	0.02198
Dmap1	1.53	0.60969	0.00126	0.02412
Lrsam1	1.53	0.60958	0.00462	0.04372
Dlgap5	1.53	0.60899	0.00342	0.03828
Fggy	1.52	0.60870	0.00011	0.00762
Psmd14	1.52	0.60818	0.00353	0.03868
Uevld	1.52	0.60813	0.00015	0.00909
AU040320	1.52	0.60805	0.00043	0.01460

Kif2a	1.52	0.60576	0.00414	0.04165
Tmem82	1.52	0.60560	0.00024	0.01123
Tceanc	1.52	0.60466	0.00425	0.04218
Arl8a	1.52	0.60431	0.00262	0.03426
Pdzd11	1.52	0.60394	0.00417	0.04171
Sox6	1.52	0.60269	0.00281	0.03547
Wdsub1	1.52	0.60181	0.00394	0.04077
Txn1	1.52	0.60158	0.00100	0.02190
Itgb5	1.52	0.60138	0.00324	0.03745
Tbc1d7	1.52	0.60086	0.00140	0.02561
Ahnak	1.52	0.60078	0.00265	0.03449
Mbnl2	1.52	0.59957	0.00244	0.03345
Rabl3	1.52	0.59935	0.00051	0.01585
Mpp5	1.51	0.59916	0.00497	0.04542
Ermard	1.51	0.59804	0.00004	0.00470
Ndufs4	1.51	0.59715	0.00005	0.00488
4833408D11Rik	1.51	0.59475	0.00048	0.01530
Hibch	1.51	0.59432	0.00047	0.01523
Pyroxd1	1.51	0.59301	0.00027	0.01179
Cyp4f15	1.51	0.59272	0.00027	0.01179
Plekha1	1.51	0.59233	0.00162	0.02756
Zrsr2	1.51	0.59125	0.00090	0.02071
Tap2	1.51	0.59016	0.00251	0.03368
Aig1	1.50	0.58972	0.00402	0.04113
Wdr62	1.50	0.58872	0.00395	0.04077
Pttg1ip	1.50	0.58766	0.00037	0.01374
Vcp	1.50	0.58763	0.00122	0.02386
Whamm	1.50	0.58754	0.00333	0.03796
Ccdc181	1.50	0.58668	0.00157	0.02701
Stom	1.50	0.58661	0.00343	0.03830
Ywhaz	1.50	0.58582	0.00104	0.02216
Sh3bgrl2	1.50	0.58428	0.00289	0.03599
1110012L19Rik	1.50	0.58400	0.00126	0.02410
Gpt	1.50	0.58343	0.00007	0.00611
Hs2st1	1.50	0.58283	0.00410	0.04142
Kctd15	1.50	0.58273	0.00417	0.04171
G3bp2	1.50	0.58269	0.00094	0.02126
N6amt2	1.50	0.58263	0.00196	0.03030
Znr1as	1.50	0.58217	0.00036	0.01361

Psmb8	1.50	0.58176	0.00547	0.04760
Sdc4	1.50	0.58153	0.00019	0.01028
Dync1i2	1.50	0.58088	0.00053	0.01608
Wash	1.50	0.58078	0.00136	0.02520
Cnih4	1.50	0.58073	0.00029	0.01228
St5	1.50	0.58071	0.00281	0.03546
S100a13	0.66	-0.59000	0.00158	0.02702
Pcf11	0.66	-0.59001	0.00305	0.03664
Luc7l3	0.66	-0.59059	0.00269	0.03471
1110038B12Rik	0.66	-0.59087	0.00010	0.00745
Ttpal	0.66	-0.59238	0.00108	0.02264
Ifitm2	0.66	-0.59592	0.00177	0.02872
Bag4	0.66	-0.60209	0.00214	0.03137
Gtpbp4	0.66	-0.60248	0.00231	0.03257
Des	0.66	-0.60340	0.00433	0.04260
Ankrd9	0.66	-0.60400	0.00051	0.01585
Cdyl2	0.66	-0.60469	0.00594	0.04981
Tubg1	0.66	-0.60584	0.00041	0.01431
Vkorc1	0.66	-0.60596	0.00002	0.00321
Usp7	0.66	-0.60842	0.00473	0.04420
Bclaf1	0.66	-0.60970	0.00196	0.03030
Wdr26	0.66	-0.61027	0.00147	0.02607
Kbtbd8	0.65	-0.61465	0.00592	0.04979
Pltp	0.65	-0.61588	0.00006	0.00572
Caln1	0.65	-0.61784	0.00521	0.04635
Cp	0.65	-0.61953	0.00408	0.04137
Atf7	0.65	-0.62028	0.00243	0.03340
Usp53	0.65	-0.62032	0.00118	0.02343
Yae1d1	0.65	-0.62036	0.00186	0.02961
Rabac1	0.65	-0.62049	0.00042	0.01449
Thap2	0.65	-0.62208	0.00095	0.02132
BB182297	0.65	-0.62411	0.00271	0.03485
Akap12	0.65	-0.62420	0.00017	0.00967
C630043F03Rik	0.65	-0.62745	0.00260	0.03420
Zfp629	0.65	-0.62906	0.00022	0.01074
Ttc30a1	0.64	-0.63330	0.00095	0.02127
Hook1	0.64	-0.63464	0.00145	0.02595
Gngt2	0.64	-0.63528	0.00274	0.03498
Tmem191c	0.64	-0.63609	0.00072	0.01830

Tpst1	0.64	-0.63693	0.00149	0.02630
Ube2q1	0.64	-0.64037	0.00348	0.03842
Foxa3	0.64	-0.64088	0.00361	0.03925
Gimap9	0.64	-0.64151	0.00125	0.02406
Guca1a	0.64	-0.64200	0.00495	0.04533
Zfp949	0.64	-0.64477	0.00175	0.02857
2300009A05Rik	0.64	-0.64544	0.00093	0.02104
Casp8	0.64	-0.64545	0.00416	0.04165
Pbld2	0.64	-0.64613	0.00334	0.03804
Aldh3a2	0.64	-0.64894	0.00198	0.03040
Ilf2	0.64	-0.65089	0.00014	0.00884
Pradc1	0.64	-0.65141	0.00393	0.04074
Rpa3	0.64	-0.65449	0.00075	0.01870
C8b	0.63	-0.65651	0.00313	0.03710
Tnxb	0.63	-0.65899	0.00173	0.02833
Ifna2	0.63	-0.66029	0.00388	0.04046
Rap1gds1	0.63	-0.66415	0.00033	0.01318
Cyp3a25	0.63	-0.66418	0.00416	0.04165
Gm5113	0.63	-0.66593	0.00143	0.02577
Ccr5	0.63	-0.67130	0.00302	0.03656
Pyhin1	0.63	-0.67189	0.00025	0.01152
Nans	0.63	-0.67394	0.00474	0.04426
Pnn	0.63	-0.67444	0.00317	0.03723
Arl5b	0.63	-0.67452	0.00423	0.04211
Arhgap9	0.63	-0.67587	0.00336	0.03804
Cpne1	0.62	-0.67878	0.00255	0.03398
Mogs	0.62	-0.67920	0.00056	0.01665
Metrn	0.62	-0.68170	0.00046	0.01506
Tspan33	0.62	-0.68459	0.00061	0.01732
4933431K14Rik	0.62	-0.68731	0.00368	0.03957
Srd5a1	0.62	-0.68820	0.00356	0.03889
Vegfa	0.62	-0.68859	0.00216	0.03146
Abcg3	0.62	-0.68910	0.00495	0.04534
Pald1	0.62	-0.68966	0.00012	0.00808
Rfxap	0.62	-0.69016	0.00336	0.03804
Derl3	0.62	-0.69030	0.00241	0.03335
Fam184a	0.62	-0.69068	0.00062	0.01742
Haus7	0.62	-0.69133	0.00100	0.02179
Slc25a28	0.62	-0.69141	0.00112	0.02293

Tada2b	0.62	-0.69380	0.00435	0.04263
Msh2	0.61	-0.70383	0.00511	0.04601
Rdh9	0.61	-0.70475	0.00335	0.03804
Igkv8-30	0.61	-0.70846	0.00228	0.03231
Tpp2	0.61	-0.71017	0.00155	0.02678
Hexim1	0.61	-0.71476	0.00319	0.03729
Slc27a2	0.61	-0.71655	0.00065	0.01780
Nrep	0.61	-0.72095	0.00348	0.03842
Msl1	0.61	-0.72244	0.00244	0.03345
Igfals	0.61	-0.72245	0.00046	0.01501
Irgq	0.61	-0.72376	0.00526	0.04663
Stbd1	0.60	-0.72659	0.00432	0.04250
Dnajb1	0.60	-0.72907	0.00014	0.00884
Igj	0.60	-0.73048	0.00029	0.01241
Zfp39	0.60	-0.73097	0.00207	0.03102
Glo1	0.60	-0.73110	0.00124	0.02397
Cyp2c70	0.60	-0.73737	0.00072	0.01827
1810009N02Rik	0.60	-0.74030	0.00145	0.02593
Fam120aos	0.60	-0.74083	0.00027	0.01179
Pcmdt1	0.60	-0.74276	0.00184	0.02936
Ccdc85b	0.60	-0.74348	0.00004	0.00455
P2ry13	0.60	-0.74441	0.00519	0.04633
Pqlc1	0.60	-0.74445	0.00380	0.04014
Hapln4	0.60	-0.74836	0.00063	0.01765
Slc40a1	0.60	-0.74886	0.00056	0.01665
4930453N24Rik	0.60	-0.74887	0.00072	0.01830
Ivns1abp	0.59	-0.76704	0.00457	0.04357
Tbc1d2b	0.58	-0.77381	0.00015	0.00909
Macrod1	0.58	-0.77578	0.00223	0.03193
Cyp7b1	0.58	-0.77821	0.00104	0.02221
Ifit2	0.58	-0.78287	0.00248	0.03355
Echdc2	0.58	-0.79138	0.00208	0.03111
Cd163l1	0.58	-0.79626	0.00429	0.04241
A1cf	0.58	-0.79697	0.00003	0.00414
Irgm1	0.57	-0.79968	0.00096	0.02137
LOC102643033	0.57	-0.80585	0.00014	0.00863
Pcyox1	0.57	-0.80901	0.00075	0.01870
Nop56	0.57	-0.81076	0.00028	0.01220
Hsd17b2	0.57	-0.81125	0.00122	0.02386

Srp54b	0.57	-0.81915	0.00455	0.04352
Nup160	0.57	-0.82091	0.00010	0.00725
Fam117a	0.57	-0.82249	0.00003	0.00395
Tppp	0.56	-0.82556	0.00500	0.04551
Slbp	0.56	-0.83213	0.00492	0.04516
Mfhas1	0.56	-0.83960	0.00002	0.00330
B3galnt1	0.56	-0.84559	0.00264	0.03449
Igfbp2	0.55	-0.84957	0.00381	0.04018
S100a1	0.55	-0.85302	0.00000	0.00213
Inhbc	0.55	-0.85569	0.00066	0.01780
Zfp280b	0.55	-0.85819	0.00037	0.01383
Itih3	0.55	-0.86002	0.00032	0.01290
5430416N02Rik	0.55	-0.86983	0.00040	0.01425
Slc7a2	0.55	-0.87012	0.00101	0.02196
Metrn1	0.55	-0.87370	0.00143	0.02577
Pdgfc	0.55	-0.87497	0.00292	0.03609
Srsf3	0.54	-0.88111	0.00053	0.01605
Ppp1r3c	0.54	-0.88244	0.00247	0.03355
Paqr9	0.54	-0.89497	0.00315	0.03722
Tnfaip8l1	0.54	-0.89781	0.00012	0.00808
Dhx58	0.53	-0.90892	0.00198	0.03042
Pdilt	0.53	-0.91210	0.00202	0.03055
Dnph1	0.53	-0.92035	0.00042	0.01433
Mfsd12	0.53	-0.92429	0.00064	0.01765
Irgm2	0.53	-0.92809	0.00082	0.01971
Lrrc16a	0.52	-0.94677	0.00260	0.03420
Defb1	0.52	-0.94700	0.00092	0.02090
Grem2	0.52	-0.95096	0.00425	0.04219
Ndufaf2	0.52	-0.95484	0.00086	0.02018
5330438D12Rik	0.51	-0.95982	0.00483	0.04469
Srgap3	0.51	-0.97139	0.00028	0.01218
Cml1	0.51	-0.97196	0.00073	0.01835
Crot	0.51	-0.98280	0.00257	0.03409
Slco1a4	0.50	-0.98637	0.00003	0.00395
Tm9sf1	0.50	-0.98748	0.00214	0.03137
Elovl2	0.50	-0.99966	0.00344	0.03834
Vegfb	0.50	-1.00256	0.00076	0.01872
Cpeb4	0.49	-1.02507	0.00212	0.03133
Il1r1	0.49	-1.03004	0.00142	0.02577

Avpr1a	0.49	-1.03903	0.00494	0.04526
Tspyl2	0.49	-1.03932	0.00519	0.04633
Fras1	0.48	-1.04932	0.00168	0.02798
Cables2	0.48	-1.05179	0.00002	0.00343
Plcxd2	0.48	-1.06477	0.00480	0.04458
Lin7a	0.48	-1.07240	0.00113	0.02308
Erdr1	0.48	-1.07291	0.00183	0.02931
Ddit3	0.47	-1.07586	0.00177	0.02870
Gm4951	0.47	-1.07655	0.00015	0.00899
Cyp2c44	0.47	-1.08391	0.00360	0.03918
Ppm1m	0.47	-1.10337	0.00101	0.02196
Pold2	0.46	-1.10529	0.00052	0.01585
Ccdc30	0.45	-1.14007	0.00292	0.03609
Tm2d2	0.45	-1.14921	0.00067	0.01782
4933411B09Rik	0.45	-1.15719	0.00431	0.04250
Hacl1	0.44	-1.18259	0.00142	0.02577
Efna1	0.44	-1.19362	0.00405	0.04116
Pdia6	0.44	-1.19407	0.00454	0.04340
Herpud1	0.41	-1.26975	0.00395	0.04077
Zfp963	0.41	-1.28101	0.00014	0.00884
Adamdec1	0.41	-1.28363	0.00465	0.04382
Hspb1	0.41	-1.29560	0.00151	0.02652
Slc16a6	0.40	-1.31335	0.00135	0.02518
5430417L22Rik	0.40	-1.33973	0.00044	0.01471
Al195470	0.39	-1.34878	0.00096	0.02144
Ppp1r3b	0.39	-1.36542	0.00498	0.04545
Cyp2d13	0.39	-1.36575	0.00098	0.02170
Sox6os	0.38	-1.39592	0.00065	0.01780
Cdk2	0.37	-1.41564	0.00110	0.02275
Gpr110	0.37	-1.41620	0.00013	0.00863
Pik3r1	0.37	-1.42785	0.00389	0.04054
Notum	0.35	-1.52127	0.00003	0.00395
Egfr	0.35	-1.52624	0.00118	0.02343
Ostc	0.33	-1.58012	0.00242	0.03338
Nrn1	0.33	-1.60291	0.00366	0.03948
Hsd17b6	0.33	-1.60770	0.00049	0.01550
Mpp4	0.33	-1.61726	0.00265	0.03449
Gas1	0.32	-1.62655	0.00006	0.00572
Cadm4	0.32	-1.65468	0.00022	0.01081

Tial1	0.32	-1.65567	0.00003	0.00382
Fabp5	0.31	-1.67389	0.00562	0.04836
Serpina7	0.31	-1.69143	0.00386	0.04044
S1pr1	0.31	-1.70034	0.00018	0.01000
Cadps2	0.31	-1.70428	0.00202	0.03051
Aox3	0.30	-1.72610	0.00000	0.00120
2900064B18Rik	0.25	-2.02260	0.00498	0.04545
Pgp	0.23	-2.12056	0.00012	0.00808
Lect1	0.21	-2.22855	0.00004	0.00466
Gm16551	0.19	-2.40591	0.00039	0.01402
Dio1	0.17	-2.54918	0.00071	0.01827
Adh6-ps1	0.12	-3.09508	0.00553	0.04784
Gm2788	0.07	-3.82958	0.00006	0.00521
Ugt2b38	0.02	-5.84085	0.00002	0.00343
Moxd1	0.01	-6.55622	0.00034	0.01331

Supplemental Table 1. Genes with a Fold Change (FC)>1.5 and a statistically significant difference (Q -value<0.05) are listed. Microarray data was obtained in pre-symptomatic, 3-month old wild-type and *Atp7b*^{-/-} mice.

Supplemental Methods

Hepatic metabolite measurements

Analysis were carried out on 1290 high-performance liquid chromatography with a degasser, binary pump, thermostat auto sampler and column oven (Agilent Technologies, Santa Clara, CA) connected to mass spectrometry equipped with electrospray ionization (ESI). The typical operating source parameters used were as follows: Gas temperature 250°C; Gas flow 14 l/min; Nebulizer gas pressure is 20 psi; Sheath gas temperature is 350°C; Sheath gas flow is 12 l/min; Capillary voltage 3000 V negative; Nozzle voltage 1500 V negative. The metabolites were separated on column ((Luna 3 μ M NH₂ 100A⁰, 150 \times 2 mm) using mobile phase A and B comprised of 5mM ammonium acetate in water and 100% acetonitrile, respectively. The gradient program is as follow: 0 min-80% of B (0.2ml/min); 20 min- 2% of B (0.2ml/min), 20.1 min-2% of B (0.3ml/min), 25 min-80% B (0.3ml/min), 30 min 80% of B(0.35ml/min), 35min 80% of B (0.4ml/min), 37.8 min 80% of B (0.4ml/min) 37.99 min 80% B (0.2ml) followed by re-equilibration end of the gradient 37.99 min to the initial starting condition 80% B. Approximately 8–11 data points were acquired per detected metabolite. All the standards were acquired in the scan mode mass range 50-1200 Da using ESI negative mode. The most abundant fragment ions were used as quantifiers. All the metabolites were measured by multiple reaction-monitoring (MRM) mode.

Glycolytic and TCA cycle metabolites were extracted with 750 μ L of ice-cold methanol: water (4:1) containing 20 μ L spiked internal standard. Ice-cold chloroform and water were added in a 3:1 ratio for a final proportion of 4:3:2 methanol: chloroform: water. Both the organic and aqueous layers were combined, dried and suspended in 50:50 methanol: water. The suspended samples were subjected to deproteinization using a 3kDa molecular filter (Amicon ultracel-3K Membrane; Millipore Corporation, Billerica, MA), and the filtrate was dried under vacuum

(Genevac EZ-2plus, NY). Prior to mass spectrometry, the dried extracts were suspended in 50:50 methanol: water and subjected to LC-MS/MS.

Hyperinsulinemic euglycemic clamp

Mice were anesthetized, and a midline neck incision was made to expose the jugular vein. A microcannula was inserted into the jugular vein, threaded into the right atrium, and anchored at the venotomy site. Mice were allowed to recover for 4 days with *ad libitum* access to water and food. Following an overnight fast, the conscious mice received a primary infusion (10 μCi) and then a constant rate intravenous infusion (0.1 $\mu\text{Ci}/\text{min}$) of chromatography-purified [$3\text{-}^3\text{H}$]-glucose using a syringe infusion pump. For determination of basal glucose production, blood samples were collected after 50 and 60 min of labeled glucose infusion. After 60 min, mice were infused continuously for 2 hours with human insulin (2.5 mU/kg/min). Simultaneously, 25% glucose was infused using another infusion pump at a rate adjusted to maintain the blood glucose level at 100–140 mg/dl (euglycemia). Blood glucose concentration was measured every 10 min by a glucometer, and glucose production rate, peripheral glucose disposal rate, and glucose infusion rate were then calculated. To estimate insulin-stimulated glucose uptake in individual tissues 2- ^{14}C -deoxyglucose (2DG) was administered as a bolus (10 μCi) at 45 min before the end of the clamps. Glucose uptake in different tissues was calculated from plasma 2- ^{14}C deoxyglucose profile fitted with double exponential curve and tissue content of 2- ^{14}C deoxyglucose-6-phosphate.