

Subpanel	Gene	OMIM gene ID	Disease/Mouse model/Cellular function	OMIM disease ID	Reference/GeneCards link/MGI ID (if not in OMIM)
Isolated lipedema	<i>AKR1C1</i>	*600449	Lipedema	/	doi:10.3390/ijms21176264
Syndromic subcutaneous fat tissue accumulation	<i>ALDH18A1</i>	*138250	Cutis laxa, fat pads and retinopathy	/	doi:10.1016/j.ejpn.2014.01.003
	<i>NSD1</i>	*606681	Sotos syndrome with diabetes, asthma, lipedema	/	doi:10.1016/j.ejmg.2009.06.001
	<i>POU1F1</i>	*173110	Combined pituitary deficiency and lipedema	/	doi:10.1055/s-0029-1224154
	<i>TBL1XR1</i>	*608628	Pierpont syndrome	#602342	
Differential diagnosis	<i>ADCY3</i>	*600291	Severe obesity	/	doi:10.1038/s41588-017-0023-6
	<i>AKT2</i>	*164731	<i>AKT2</i> -linked lipodystrophy	/	doi:10.1016/j.ecl.2017.01.012
	<i>ADRA2A</i>	*104210	Atypical familial partial lipodystrophy	/	doi:10.1172/jci.insight.86870
	<i>AGPAT2</i>	*603100	FPLD1	#608594	
	<i>CAV1</i>	*601047	FPLD7	#606721	
	<i>CIDEA</i>	*612120	FPLD5	#615238	
	<i>LIPE</i>	*151750	FPLD6	#615980	
	<i>LMNA</i>	*150330	FPLD2	#151660	
	<i>MFN2</i>	*608507	<i>MFN2</i> -associated lipomatosis	/	doi:10.1016/j.jacl.2018.07.009
	<i>PALB2</i>	*610355	Familial multiple subcutaneous lipomatosis	/	doi:10.1016/j.hemonc.2016.01.001
	<i>PLIN1</i>	*170290	FPLD4	#613877	
	<i>PPARG</i>	*601487	FPLD3 Obesity, severe	#604367 #601665	
	<i>CCBE1</i>	*612753	HKLLS1	#235510	
	<i>FLT4</i>	*136352	LMPHM1	#153100	
	<i>FOXC2</i>	*602402	LPHDST	#153400	
	<i>GATA2</i>	*137295	Primary lymphedema with myelodysplasia	#614038	
	<i>GJA1</i>	*121014	Oculodentodigital syndrome and primary lymphedema	/	doi:10.1111/cge.12158

	<i>HGF</i>	*142409	Primary lymphedema	/	doi:10.1089/lrb.2008.1524
	<i>ALMS1</i>	*606844	ALMS	#203800	
	<i>ARL6</i>	*608845	BBS3	#600151	
	<i>BBIP1</i>	*613605	BBS18	#615995	
	<i>BBS1</i>	*209901	BBS1	#209900	
	<i>BBS10</i>	*610148	BBS10	#615987	
	<i>BBS12</i>	*610683	BBS12	#615989	
	<i>BBS2</i>	*606151	BBS2	#615981	
	<i>BBS4</i>	*600374	BBS4	#615982	
	<i>BBS5</i>	*603650	BBS5	#615983	
	<i>BBS7</i>	*607590	BBS7	#615984	
	<i>PTHB1</i>	*607968	BBS9	#615986	
	<i>C8orf37</i>	*614477	BBS21	#617406	
	<i>CEP19</i>	*615586	Morbid obesity and spermatogenic failure	#615703	
	<i>CEP290</i>	*610142	BBS14	#615991	
	<i>DYRK1B</i>	*604556	Abdominal obesity-metabolic syndrome 3	#615812	
	<i>GNAS</i>	*139320	PHP1A PHP1B PHP1C pseudoPHP	#103580 #603233 #612462 #612463	
	<i>HDAC8</i>	*300269	CDLS5	#300882	
	<i>IFT172</i>	*607386	BBS20	#619471	
	<i>IFT27</i>	*615870	BBS19	#615996	
	<i>INPP5E</i>	*613037	Mental retardation, truncal obesity, retinal dystrophy, micropenis	#610156	
	<i>INSR</i>	*147670	HHF5	#609968	
	<i>KSR2</i>	*610737	Obesity, insulin resistance, impaired cellular fuel oxidation	/	doi:10.1016/j.cell.2013.09.058
	<i>LEP</i>	*164160	Morbid obesity	#614962	
	<i>LEPR</i>	*601007	Morbid obesity	#614963	
	<i>LZTFL1</i>	*606568	BBS17	#615994	
	<i>MC3R</i>	*155540	Non-syndromic early-onset obesity	/	doi:10.1038/s41366-019-0357-5
	<i>MC4R</i>	*155541	Obesity	#618406	

	<i>MEGF8</i>	*604267	CRPT2	#614976	
	<i>MKKS</i>	*604896	BBS6	#605231	
	<i>MKS1</i>	*609883	BBS13	#615990	
	<i>NR0B2</i>	*604630	Early-onset mild obesity	#601665	
	<i>PCSK1</i>	*162150	Obesity with impaired prohormone processing	#600955	
	<i>PHF6</i>	*300414	BFLS	#301900	
	<i>POMC</i>	*176830	Obesity, adrenal insufficiency, red hair	#609734	
	<i>PPP1R3A</i>	*600917	Severe insulin resistance	#125853	
	<i>RAB23</i>	*606144	CRPT1	#201000	
	<i>SDCCAG8</i>	*613524	BBS16	#615993	
	<i>SH2B1</i>	*608937	Severe early-onset obesity	/	doi:10.1172/JCI62696
	<i>SIM1</i>	*603128	Obesity	/	doi:10.1007/s11695-019-04184-w
	<i>TRIM32</i>	*602290	BBS11	#615988	
	<i>TTC8</i>	*608132	BBS8	#615985	
	<i>VPS13B</i>	*607817	Cohen syndrome	#216550	
Candidate genes	<i>WDPCP</i>	*613580	BBS15	#615992	
	<i>A2M</i>	*103950	Inflammatory cytokines inhibitor	/	doi:10.1152/ajpregu.00335.2014
	<i>ABCC6</i>	*603234	Pseudoxanthoma elasticum	#264800	
	<i>ABCG1</i>	*603076	Cellular lipid homeostasis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=ABCG1&keywords=ABCG1
	<i>ACBD7</i>	/	Medium- and long-chain acyl-CoA esters binding	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=ACBD7&keywords=ACBD7
	<i>ACSL1</i>	*152425	Increased body fat mass	/	MGI:102797
	<i>ACVR1C</i>	*608981	Body fat distribution	/	doi:10.1210/clinem/dgab877
	<i>ADIG</i>	*611396	Abnormal adipose tissue development	/	MGI:2675492
	<i>ADIPOQ</i>	*605441	Adiponectin deficiency	#612556	
	<i>ADRB2</i>	+109690	Obesity, type 2 diabetes	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=ADRB2&keywords=ADRB2
	<i>ADRB3</i>	*109691	Increased total body fat amount	/	MGI:87939
	<i>AEBP1</i>	*602981	Abnormal fat cell morphology	/	MGI:1197012
	<i>AGRP</i>	*602311	Abnormal energy expenditure	/	MGI:892013
	<i>AKR1B1</i>	*103880	Steroid hormones metabolism	/	https://www.genecards.org/cgi-

					bin/carddisp.pl?gene=AKR1B1&keywords=AKR1B1
	<i>AKR1B10</i>	*604707	Detoxification of dietary and lipid-derived unsaturated carbonyls	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=AKR1B10&keywords=AKR1B10
	<i>AKR1B15</i>	*616336	Steroid hormones metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=AKR1B15&keywords=AKR1B15
	<i>AKR1C2</i>	*600450	Regulation of estrogens and androgens metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=AKR1C2&keywords=AKR1C2
	<i>AKR1C3</i>	*603966	Steroid hormones metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=AKR1C3&keywords=AKR1C3
	<i>AKR1C4</i>	*600451	Steroid hormones metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=AKR1C4&keywords=AKR1C4
	<i>AKR1E2</i>	*617451	Steroid hormones metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=AKR1E2&keywords=AKR1E2
	<i>ANGPTL4</i>	*605910	Abnormal lipid homeostasis Abnormal lymphatic vessel morphology	/	MGI:1888999
	<i>ANK2</i>	*106410	Increased fat cell size	/	MGI:88025
	<i>ANKRD26</i>	*610855	Regulator of adipogenesis and feeding behavior	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=ANKRD26&keywords=ANKRD26
	<i>ANXA1</i>	*151690	Abnormal adipose tissue morphology and physiology	/	MGI:96819
	<i>APOA1</i>	*107680	Promotion of cholesterol efflux from tissues	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=APOA1&keywords=APOA1
	<i>APOE</i>	*107741	Lipid transport between organs via the plasma and interstitial fluids	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=APOE&keywords=APOE
	<i>ARNTL</i>	*602550	Dyslipidemia, ectopic fat formation, altered energy homeostasis	/	MGI:1096381
	<i>ARRDC3</i>	*612464	Body mass and energy expenditure regulation	/	doi:10.1016/j.cmet.2011.08.011
	<i>ATG12</i>	*609608	Increased body fat mass	/	MGI:1914776
	<i>ATXN1</i>	*601556	Association with ectopic-fat	/	doi: 10.1038/ng.3738
	<i>BAIAP3</i>	*604009	Behavior and food intake regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=BAIAP3&keywords=BAIAP3
	<i>BDNF</i>	*113505	Body weight gain	/	doi:10.1007/s11064-021-03523-7

<i>BECN2</i>	*615687	Increased body weight	/	MGI:2684950
<i>BRD2</i>	*601540	Increased total body fat amount	/	MGI:99495
<i>BRS3</i>	*300107	Regulation of metabolic rate, glucose metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=BRS3&keywords=BRS3
<i>BSCL2</i>	*606158	CGL2	#269700	
<i>CADM2</i>	*609938	Obesity	/	doi:10.1038/s41598-019-43861-9
<i>CAMKK2</i>	*615002	Increased percent body fat/body weight	/	MGI:2444812
<i>CARTPT</i>	*602606	Susceptibility to obesity	#601665	
<i>CAVIN1</i>	*603198	CGL4	#613327	
<i>CD300E</i>	*609801	Neutrophil-mediated inflammation in adipose tissue	/	doi:10.1371/journal.pone.0125718
<i>CDKN1A</i>	*116899	Increased white fat cell number	/	MGI:104556
<i>CDKN1B</i>	*600778	Increased white fat cell number	/	MGI:104565
<i>CIDEA</i>	*604440	Role in thermogenesis and lipolysis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=CIDEA&keywords=CIDEA
<i>CLOCK</i>	*601851	Increased body weight	/	MGI:99698
<i>CNR1</i>	*114610	Role in diet-induced obesity, dyslipidemia, liver steatosis, lipogenesis, energy expenditure, feeding behavior	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=CNR1&keywords=CNR1
<i>CNTNAP2</i>	*604569	Diet-induced obesity.	/	doi:10.1007/s00335-012-9400-8
<i>COL3A1</i>	*120180	Adipose tissue inflammation	/	MGI:88453
<i>CPE</i>	*114855	BDV syndrome	#619326	
<i>CPEB4</i>	*610607	Obesity	/	doi:10.1155/2018/3848560
<i>CRY2</i>	*603732	Glucose and lipid metabolism modulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=CRY2&keywords=CRY2
<i>CYP19A1</i>	*107910	Synthesis of cholesterol, steroids and other lipids	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=CYP19A1&keywords=CYP19A1
<i>DNAAF1</i>	*613193	Morbid obesity	/	doi:10.3390/genes5030709
<i>EBF1</i>	*164343	Regulation of lipid metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=EBF1&keywords=EBF1
<i>ELN</i>	*130160	WBS	#194050	doi:10.1002/ajmg.a.30400
<i>ENPP1</i>	*173335	Susceptibility to obesity	#601665	
<i>EPAS1</i>	*603349	Insulin resistance and obesity	/	doi:10.3390/life11060552

	<i>ESR1</i>	*133430	Increased white fat cell number and size	/	MGI:1352467
	<i>ESRRA</i>	*601998	Regulation of lipid metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=ESRRA&keywords=ESRRA
	<i>FABP2</i>	*134640	Intracellular transport of long-chain fatty acids and their acyl-CoA esters, triglyceride-rich lipoprotein synthesis, lipid sensor for energy homeostasis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=FABP2&keywords=FABP2
	<i>FABP4</i>	*600434	Lipid transport in adipocytes. Delivery of long-chain fatty acids to their receptors in the nucleus	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=FABP4&keywords=FABP4
	<i>FFAR4</i>	*609044	Susceptibility to obesity	#607514	
	<i>FGF21</i>	*609436	Glucose uptake stimulation in differentiated adipocytes	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=FGF21&keywords=FGF21
	<i>FOXO1</i>	/	Regulation of metabolic homeostasis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=FOXO1&keywords=FOXO1
	<i>FTO</i>	*610966	Susceptibility to obesity	#612460	
	<i>FZD9</i>	*601766	Modulation in adipose tissue by chronic hyperadiponectinemia	/	doi:10.1371/journal.pone.0067712
	<i>GCKR</i>	*600842	Glucokinase regulation by forming an inactive complex with glucokinase	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GCKR&keywords=GCKR
	<i>GDF15</i>	*605312	Food intake, energy expenditure, body weight regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GDF15&keywords=GDF15
	<i>GDF3</i>	*606522	Adipose-tissue homeostasis, energy balance regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GDF3&keywords=GDF3
	<i>GFRAL</i>	*617837	Food intake, energy expenditure, body weight regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GFRAL&keywords=GFRAL
	<i>GHR</i>	*600946	Increased total body fat amount	/	MGI:95708
	<i>GHRL</i>	*605353	Susceptibility to obesity	#601665	
	<i>GHSR</i>	*601898	Energy homeostasis and body weight regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GHSR&keywords=GHSR
	<i>GPD1</i>	*138420	Critical role in carbohydrate and lipid metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GPD1&keywords=GPD1
	<i>GPR26</i>	*604847	Increased susceptibility to diet-induced	/	MGI:2441758

			obesity with increased food intake		
	<i>GPR82</i>	*300748	Abnormal adipose tissue amount	/	MGI:2441734
	<i>GPRC6A</i>	*613572	Coordination of nutritional and hormonal signals through anabolic steroids	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GPRC6A&keywords=GPRC6A
	<i>GRB14</i>	*601524	Insulin receptor signaling inhibitor that regulates growth and metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GRB14&keywords=GRB14
	<i>GRIK1</i>	*138245	Severe early-onset obesity	/	doi:10.1371/journal.pgen.1006657
	<i>GRPR</i>	*305670	Contribution to the regulation of food intake	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GRPR&keywords=GRPR
	<i>GSDMB</i>	*611221	Adipocyte development and differentiation	/	doi:10.1038/ng.3738
	<i>GSK3A</i>	*606784	Negative regulator in the hormonal control of glucose homeostasis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GSK3A&keywords=GSK3A
	<i>GSK3B</i>	*605004	Negative regulator of glucose homeostasis involved in energy metabolism, inflammation, mitochondrial dysfunction	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=GSK3B&keywords=GSK3B
	<i>GUCY2C</i>	*601330	Increased subcutaneous adipose tissue amount	/	MGI:106903
	<i>H6PD</i>	*138090	Cortisone reductase deficiency 1	#604931	
	<i>HDAC4</i>	*605314	High <i>HDAC4</i> expression in visceral adipose tissue in obese. <i>HDAC4</i> is negatively correlated with pro-inflammatory cytokines	/	doi:10.1080/13813455.2020.1734843
	<i>HIF1A</i>	*603348	HIF-1 α activity contributes to chronic inflammation in obesity.	/	doi:10.1152/ajpendo.00626.2010
	<i>HIPK2</i>	*606868	Essential regulator of white fat development	/	doi:10.1073/pnas.1322275111
	<i>HMGA2</i>	*600698	Role in adipogenesis and mesenchymal differentiation. Knockout study in mouse shows that <i>HMGA2</i> is involved in diet-induced obesity	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=HMGA2&keywords=HMGA2
	<i>HOXA1</i>	*142955	Expression linked with fat accumulation in brown adipocytes	/	doi:10.1016/j.gep.2016.01.002
	<i>HOXA10</i>	*142957	Expression linked with fat accumulation in brown adipocytes	/	doi:10.1016/j.gep.2016.01.002

	<i>HOXA2</i>	*604685	Expressed in adipose tissue	/	doi:10.1210/jc.2012-2953
	<i>HOXA4</i>	*142953	Expression linked with fat accumulation in brown adipocytes	/	doi:10.1016/j.gep.2016.01.002
	<i>HOXA5</i>	*142952	Expression linked with fat accumulation in brown adipocytes	/	doi:10.1016/j.gep.2016.01.002
	<i>HOXB4</i>	*142965	Upregulated during adipocyte development	/	doi:10.1186/gb-2010-11-8-r80
	<i>HOXB8</i>	*142963	Expressed in adipose tissue	/	doi:10.1210/jc.2012-2953
	<i>HOXC13</i>	*142976	Body fat distribution modulation	/	doi:10.1038/ng.685
	<i>HOXC4</i>	*142974	Expressed in adipose tissue	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=HOXC4&keywords=HOXC4
	<i>HOXC8</i>	*142970	Expressed in adipose tissue	/	doi:10.1210/jc.2012-2953
	<i>HOXD4</i>	*142981	Adipocytes differentiation	/	doi:10.3389/fphys.2014.00479
	<i>IFI35</i>	*600735	Inflammation regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=IFI35&keywords=IFI35
	<i>IFT74</i>	*608040	BBS22	#617119	
	<i>IL18</i>	*600953	Increased white adipose tissue amount	/	MGI:107936
	<i>IL6</i>	*147620	Increases lipolysis, improves insulin resistance, regulates energy and glucose homeostasis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=IL6&keywords=IL6
	<i>IL6R</i>	*147880	Energy and glucose homeostasis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=IL6R&keywords=IL6R
	<i>INSIG2</i>	*608660	Negative regulator of cholesterol biosynthesis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=INSIG2&keywords=INSIG2
	<i>IRS1</i>	+147545	Susceptibility to type 2 diabetes mellitus	#125853	
	<i>IRX3</i>	*612985	Energy metabolism regulator	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=IRX3&keywords=IRX3
	<i>ITGA9</i>	*603963	Abnormal lymph circulation	/	MGI:104756
	<i>KDM3A</i>	*611512	Involved in obesity resistance through regulation of metabolic genes	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=KDM3A&keywords=KDM3A
	<i>KLF16</i>	*606139	Lipid metabolism regulation	/	doi:10.1136/gutjnl-2020-321774
	<i>KRAS</i>	*190070	Lymphedema in developmental syndromes	/	doi:10.1038/ejhg.2015.175

	<i>LPIN1</i>	*605518	Required for adipocyte differentiation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=LPIN1&keywords=LPIN1
	<i>LRP2</i>	*600073	Critical component of the hypothalamic feeding regulatory pathway	/	doi:10.1038/ncomms2896
	<i>LRRC8A</i>	*608360	Abnormal fat cell morphology	/	MGI:2652847
	<i>LYPLAL1</i>	*616548	Obesity	/	doi:10.1016/j.mce.2015.05.001.
	<i>MAPK11</i>	*602898	Inflammatory response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=MAPK11&keywords=MAPK11
	<i>MAPK12</i>	*602399	Inflammatory response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=MAPK12&keywords=MAPK12
	<i>MAPK13</i>	*602899	Inflammatory response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=MAPK13&keywords=MAPK13
	<i>MAPK14</i>	*600289	Inflammatory response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=MAPK14&keywords=MAPK14
	<i>MC1R</i>	*155555	Negative regulation of inflammatory response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=MC1R&keywords=MC1R
	<i>MCHR1</i>	*601751	Feeding behaviors and energy metabolism control	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=MCHR1&keywords=MChR1
	<i>MED13</i>	*603808	Increased susceptibility to obesity and worsened glucose intolerance when fed a high fat diet in mice	/	MGI:3029632
	<i>MEIS1</i>	*601739	Inactivation required for adipogenesis	/	doi:10.1016/j.celrep.2018.09.086.
	<i>MLXIPL</i>	*605678	Abnormal glucose and lipid homeostasis	/	MGI:1927999
	<i>MMP19</i>	*601807	Increased fat cell size	/	MGI:1927899
	<i>MRAP2</i>	*615410	Susceptibility to obesity	#615457	
	<i>MSX2</i>	*123101	Adipogenic differentiation suppressor	/	doi:10.1074/jbc.M306972200
	<i>NBEA</i>	*604889	Abnormal interscapular fat pad morphology	/	MGI:1347075
	<i>NCOA1</i>	*602691	Required for energy control balance between white and brown adipose tissues and for mediating steroid hormone response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=NCOA1&keywords=NCOA1
	<i>NCOA2</i>	*601993	Required for energy control balance	/	https://www.genecards.org/cgi-

			between white and brown adipose tissues and for mediating steroid hormone response		bin/carddisp.pl?gene=NCOA2&keywords=NCOA2
	NCOA3	*601937	Involved in the coactivation of nuclear receptors (steroids, retinoids, prostanoids)	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=NCOA3&keywords=NCOA3
	NDN	*602117	Prader-Willi syndrome	#176270	
	NEGR1	*613173	Predisposition to obesity	#601665	
	NEIL1	*608844	Homozygous null mice develop severe obesity, dyslipidemia, fatty liver disease, hyperinsulinemia	/	MGI:1920024
	NF1	*613113	Neurofibromatosis type 1 with lymphedema	/	doi:10.3892/ol.2016.4469
	NGEF	*605991	Association with abdominal visceral fat	/	doi:10.1371/journal.pone.0137564
	NMU	*605103	Pain, stress, inflammation and feeding regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=NMU&keywords=NMU
	NPC1	*607623	Obesity	/	doi:10.2337/db16-0877
	NPY	*162640	Control of feeding and secretion of gonadotrophin-release hormone	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=NPY&keywords=NPY
	NPY4R	*601790	Obesity	/	doi:10.1002/oby.21435
	NR1D1	*602408	Regulation of lipid and bile acid metabolism, adipogenesis, gluconeogenesis, macrophage inflammatory response	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=NR1D1&keywords=NR1D1
	NR2F2	*107773	Abnormal glucose homeostasis and lipid level	/	MGI:1352452
	NR2F6	*132880	Adipocyte differentiation inhibition	/	doi:10.1074/mcp.M114.045328
	NR3C1	*138040	Negative regulation of adipogenesis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=NR3C1&keywords=NR3C1
	NTRK2	*600456	Obesity, hyperphagia, and developmental delay	#613886	
	OGG1	*601982	Maintenance of metabolic homeostasis	/	doi:10.1016/j.dnarep.2019.102667
	OMA1	*617081	Lipid metabolism regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=OMA1&keywords=OMA1

	<i>OSBPL8</i>	*606736	Lipid transporter involved in lipid countertransport between the endoplasmic reticulum and the plasma membrane	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=OSBPL8&keywords=OSBPL8
	<i>PANX1</i>	*608420	Adipose stromal cell differentiation and fat accumulation	/	doi:10.1038/s41598-018-34234-9.
	<i>PAX6</i>	*607108	Pancreatic islet alpha cells differentiation. Glucagon, insulin and somatostatin promoters binding	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=PAX6&keywords=PAX6
	<i>PBX1</i>	*176310	Overweight/obesity and metabolic alterations	/	doi:10.4162/nrp.2008.2.4.289.
	<i>PDE11A</i>	*604961	PPNAD2	#610475	
	<i>PDE3B</i>	*602047	Abnormalities in glycerol and fatty acid levels, changes in adipocyte morphology, decreased body fat percentage.	/	MGI:1333863
	<i>PDX1</i>	*600733	MODY4	#606392	
	<i>PER1</i>	*602260	Abnormal basal metabolism, body weight, estrous cycle, food intake, food preference	/	MGI:1098283
	<i>PIGC</i>	*601730	Glycosylphosphatidylinositol lipid anchor biosynthesis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=PIGC&keywords=PIGC
	<i>PIK3CA</i>	*171834	Lymphatic malformation	/	doi:10.1371/journal.pone.0200343
	<i>PITPNM1</i>	*608794	Mice homozygous for a knock-out allele exhibit decrease in circulating cholesterol	/	MGI:1197524
	<i>PNPLA2</i>	*609059	Neutral lipid storage disease with myopathy	#610717	
	<i>PPARGC1A</i>	*604517	Blood pressure, cellular cholesterol homeostasis control, development of obesity	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=PPARGC1A&keywords=PPARGC1A
	<i>PPARGC1B</i>	*608886	Increased risk of obesity.	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=PPARGC1B&keywords=PPARGC1B
	<i>PRDM16</i>	*605557	Differentiation of brown adipose tissue	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=PRDM16&keywords=PRDM16
	<i>PRDM2</i>	*601196	Specific effector of estrogen action	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=PRDM2&keywords=PRDM2
	<i>PRKAA1</i>	*602739	Cellular energy sensor	/	https://www.genecards.org/cgi-

					bin/carddisp.pl?genePRKAA1&keywords=PRKAA1
	<i>PRKAA2</i>	*600497	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAA2&keywords=PRKAA2
	<i>PRKAB1</i>	*602740	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAB1&keywords=PRKAB1
	<i>PRKAB2</i>	*602741	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAB2&keywords=PRKAB2
	<i>PRKACA</i>	*601639	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKACA&keywords=PRKACA
	<i>PRKACB</i>	*176892	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKACB&keywords=PRKACB
	<i>PRKAG1</i>	*602742	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAG1&keywords=PRKAG1
	<i>PRKAG2</i>	*602743	Cellular energy sensor	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAG2&keywords=PRKAG2
	<i>PRKAG3</i>	*604976	Skeletal muscle glycogen content and metabolism QTL	#619030	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAG3&keywords=PRKAG3
	<i>PRKAR1A</i>	*188830	Carney complex, type 1	#160980	
	<i>PRKAR2A</i>	*176910	Regulation of lipid and glucose metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAR2A&keywords=PRKAR2A
	<i>PRKAR2B</i>	*176912	Regulation of lipid and glucose metabolism	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRKAR2B&keywords=PRKAR2B
	<i>PROX1</i>	*601546	Lymphedema	/	doi:10.1002/mgg3.1424
	<i>PRRC2A</i>	*142580	Insulin-dependent diabetes mellitus	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePRRC2A&keywords=PRRC2A
	<i>PTN</i>	*162095	Proliferation promotion of adipocytes precursor cells	/	doi:10.1126/scisignal.aag0487
	<i>PYY</i>	*600781	Pancreatic secretion, gut mobility and energy homeostasis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?genePYY&keywords=PYY
	<i>RARB</i>	*180220	Association with carbohydrate intake	/	doi:10.1038/s41380-018-0079-4
	<i>RB1</i>	*614041	Retinoblastoma and lipomatosis	/	doi:10.5999/aps.2014.41.6.785.
	<i>RBP4</i>	*180250	Adipokine	/	doi:10.1530/EJE-11-0431.
	<i>RETN</i>	*605565	Susceptibility to noninsulin-dependent	#125853	

			diabetes mellitus		
	<i>RGS2</i>	*600861	Brown adipose tissue function and differentiation balance	/	doi:10.1016/j.molmet.2019.09.015
	<i>RREB1</i>	*602209	Brown adipocyte differentiation	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneRREB1&keywords=RREB1
	<i>RSC1A1</i>	*601966	Homozygous null mice develop obesity, increased serum cholesterol and leptin levels and increased absorption of D-glucose in the small intestine.	/	MGI:3526447
	<i>RSPO3</i>	*610574	Impact on body fat distribution, adipose cell biology regulation	/	doi:10.1038/s41467-020-16592-z
	<i>RYR1</i>	*180901	Hypothalamic expression	/	doi:10.1152/physiolgenomics.00006.2015
	<i>SCD</i>	*604031	Lipid biosynthesis, mitochondrial fatty acid oxidation regulation, body energy homeostasis	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSCD&keywords=SCD
	<i>SCPEP1</i>	/	Association with intramuscular fat in pigs	/	doi:10.1111/jbg.12189
	<i>SDC3</i>	*186357	Association with obesity	#601665	
	<i>SERPINA6</i>	*122500	Major transport protein for glucocorticoids and progestins in the blood	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSERPINA6&keywords=SERPINA6
	<i>SFRP1</i>	*604156	Increased adiposity, dysregulated glucose metabolism, enhanced macrophage infiltration in deficient mice	/	doi:10.1371/journal.pone.0078320
	<i>SFRP5</i>	*604158	Anti-inflammatory adipokine involved in obesity, type 2 diabetes mellitus	/	doi:10.1111/jcmm.15023
	<i>SIRT1</i>	*604479	Sensor of the cytosolic ratio of NAD(+)/NADH, influenced by glucose deprivation and caloric restriction	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSIRT1&keywords=SIRT1
	<i>SIRT6</i>	*606211	Glucose homeostasis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSIRT6&keywords=SIRT6
	<i>SKP2</i>	*601436	Adipocyte proliferation control	/	doi:10.1074/jbc.M608144200
	<i>SLC13A5</i>	*608305	Utilization of circulating citrate facilitation for the generation of metabolic energy and the synthesis of fatty acids and cholesterol	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSLC13A5&keywords=SLC13A5
	<i>SLC2A4</i>	*138190	Insulin-regulated facilitative glucose	/	https://www.genecards.org/cgi-

		transporter		bin/carddisp.pl?geneSLC2A4&keywords=SLC2A4
<i>SLC35D3</i>	*612519	Mutation in this gene causes metabolic syndrome	/	doi:10.1371/journal.pgen.1004124
<i>SLCO4C1</i>	*609013	Severe early-onset obesity	/	doi:10.1371/journal.pgen.1006657
<i>SNAP25</i>	*600322	Metabolic disease	/	doi:10.1016/j.neuroscience.2018.07.035
<i>SNRPN</i>	*182279	Prader-Willi syndrome	#176270	
<i>SREBF1</i>	*184756	Cholesterol biosynthesis and lipid homeostasis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSREBF1&keywords=SREBF1
<i>STAB1</i>	*608560	Low density lipoprotein endocytosis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSTAB1&keywords=STAB1
<i>STAT3</i>	*102582	Melanocortin production and body energy homeostasis regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneSTAT3&keywords=STAT3
<i>STAT5A</i>	*601511	Adipogenesis promotion	/	doi:10.1007/s12199-010-0193-7
<i>STAT5B</i>	*604260	Impaired glucose tolerance, increased circulating triglyceride level, increased total body fat amount	/	MGI:103035
<i>STRA6</i>	*610745	In obesity, downregulation in adipocytes and adipose stromovascular fraction	/	doi:10.1128/MCB.01106-13
<i>SYPL2</i>	/	Susceptibility to morbid obesity	/	doi:10.1038/ejhg.2014.255
<i>TAF7L</i>	*300314	Abnormal brown adipose tissue morphology, thermogenesis, differentiation	/	MGI:1921719
<i>TBC1D1</i>	*609850	Involved in the insulin-stimulated glucose uptake into cells	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneTBC1D1&keywords=TBC1D1
<i>TBC1D4</i>	*612465	Noninsulin-dependent diabetes mellitus 5	#616087	
<i>TBX15</i>	*604127	Expression positively correlated with glycolytic metabolism, inversely correlated with obesity in subcutaneous and visceral white adipose tissue	/	doi:10.2337/db17-0218
<i>TGFB1</i>	*190180	Browning of white fat	/	doi:10.1016/j.molmet.2018.07.008
<i>TGM2</i>	*190196	A homozygous null mutation causes alterations in glucose and aerobic energy metabolism	/	MGI:98731
<i>TMEM18</i>	*613220	KO homozygous mice exhibit increase in	/	MGI:2387176

			body weight, fat mass, susceptibility to diet-induced obesity, increased food intake		
	<i>TNXB</i>	*600985	Involved in fat deposition in sheep	/	doi:10.1186/s12864-018-4747-1
	<i>TRH</i>	*613879	Increased circulating cholesterol, creatinine, HDL cholesterol levels	/	MGI:98823
	<i>TRIM72</i>	*613288	Mediation of the degradation of the insulin receptor and insulin receptor substrate 1. When upregulated, metabolic syndrome featuring insulin resistance, obesity, hypertension, dyslipidaemia	/	doi:10.1038/nature11834
	<i>TRPV1</i>	*602076	Increased body weight	/	MGI:1341787
	<i>TTR</i>	*176300	Transthyretin antisense oligonucleotides improve insulin sensitivity in obese mice	/	doi:10.2337/db14-0970
	<i>TUB</i>	*601197	Retinal dystrophy and obesity	#616188	
	<i>TYK2</i>	*176941	Abnormal body temperature homeostasis, brown adipose tissue morphology, fat cell differentiation, mitochondrial physiology, decreased energy expenditure, impaired adaptive thermogenesis, glucose tolerance, increased body weight, cholesterol level, circulating free fatty acids level, circulating insulin level, obesity	/	MGI:1929470
	<i>UBE2E2</i>	*602163	Associated with ectopic-fat traits	/	doi:10.1038/ng.3738
	<i>UCP1</i>	*113730	Thermogenic respiration	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneUCP1&keywords=UCP1
	<i>UCP2</i>	*601693	Susceptibility to obesity	#607447	
	<i>UCP3</i>	*602044	Thermogenesis and energy balance	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneUCP3&keywords=UCP3
	<i>VEGFA</i>	*192240	Key factor in the regulation of angiogenesis in adipose tissue	/	doi:10.1038/s41598-017-16686-7
	<i>VEGFC</i>	*601528	Lymphatic malformation 4	#615907	
	<i>WDR13</i>	*300512	KO mice increase pancreatic islet mass and higher serum insulin levels, and are mildly obese	/	https://www.genecards.org/cgi-bin/carddisp.pl?geneWDR13&keywords=WDR13

	<i>WNT10B</i>	*601906	Molecular switch for adipogenesis	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=WNT10B&keywords=WNT10B
	<i>WNT11</i>	*603699	Obesity-induced adipose tissue inflammation and metabolic dysfunction promotion	/	doi:10.2337/db14-1164
	<i>WNT4</i>	*603490	Adipocyte differentiation promotion	/	doi:10.1016/j.febslet.2008.08.011
	<i>YWHAZ</i>	*601288	Insulin sensitivity regulation	/	https://www.genecards.org/cgi-bin/carddisp.pl?gene=YWHAZ&keywords=YWHAZ
	<i>ZEB1</i>	*189909	Impaired glucose tolerance, increased body weight, circulating adiponectin level, circulating corticosterone level, circulating free fatty acids level, circulating insulin level, circulating leptin level, circulating triglyceride level, percent body fat/body weight, increased total body fat amount, insulin resistance	/	MGI:1344313
	<i>ZMPSTE24</i>	*606480	Mandibuloacral dysplasia with type B lipodystrophy	#608612	
	<i>ZNF423</i>	*604557	Adipogenic commitment control in mice, dysregulation in human hypertrophic obesity	/	doi:10.1007/s00125-017-4471-4
	<i>ZNRF3</i>	*612062	Inhibition of Wnt/ β -catenin signaling,	/	doi:10.3389/fphys.2018.00792

Supplementary Table S1. Genes analyzed in the present study. The genes are subdivided in three subpanels: isolated lipedema, syndromic subcutaneous fat tissue accumulation, differential diagnosis, candidate genes. ALMS = Alstrom syndrome; BBS = Bardet-Biedl syndrome; BDVS = Blakemore-Durmaz-Vasileiou syndrome; BFLS = Borjeson-Forssman-Lehmann syndrome; CDLS = Cornelia de Lange syndrome; CGL = congenital generalized lipodystrophy; CRPT = Carpenter syndrome; FPLD = Familial partial lipodystrophy; HHF = Familial hyperinsulinemic hypoglycemia; HKLLS = Hennekam lymphangiectasia-lymphedema syndrome; LMPHM = Lymphatic malformation; LPHDST = Lymphedema-distichiasis; MODY = Maturity-onset diabetes of the young; PPNAD = primary pigmented nodular adrenocortical disease; PHP = Pseudohypoparathyroidism; WBS = Williams-Beuren syndrome.