

Table S1. The non-overlapping MA and MO GWA studies drawn from the 2013 IHGC GWA meta-analysis.

Study	Cases		Controls	
	MA	MO	MA	MO
deCODE		537		34,617
ERF	141		1,216	
Finnish MA	1,032		3,513	
German MA	997		1,105	
German MO		1,208		2,564
HUNT		1,175		1,097
LUMINA MA	820		4,774	
LUMINA MO		1,118		2,016
NTR&NESDA	103		2,260	
TWINS UK	235		3,837	
WGHS	1,177		18,108	
Total	4,505	4,038	34,813	40,294

Table S2. Biological functions significantly enriched for genes that overlap between MA and MO

Category	Disease or Function annotations	P-value	# of Genes	Overlapping Genes
Inflammatory Disease	Chronic inflammatory disorder	4.1×10^{-5}	30	<i>AIF1, ARIH1, ART1, ATF6B, C4A/C4B, CHRNA10, CORT, CYP19A1, DHX16, EGFL8, G0S2, GABBR1, GABRA4, HDAC7, HPGD, HSD11B1, MICA, MSH5, PLA2G2A, PRRC2A, RNF39, SPP1, STAT6, STK19, TNXB, TRIM26, TRPM8, TSPO, UFL1, WNT5A</i>
Connective Tissue Disorders, Immunological Disease, Inflammatory Disease, Skeletal and Muscular Disorders	Rheumatoid arthritis	4.7×10^{-5}	24	<i>AIF1, ARIH1, ART1, ATF6B, C4A/C4B, CYP19A1, DHX16, EGFL8, G0S2, GABRA4, HDAC7, MICA, MSH5, PLA2G2A, PRRC2A, RNF39, SPP1, STAT6, STK19, TNXB, TRIM26, TSPO, UFL1, WNT5A</i>
Organismal Injury and Abnormalities	Bleeding	6.6×10^{-5}	17	<i>C1GALT1, C4A/C4B, CHRNA10, CYP19A1, ENG, FAIM, GABRA4, HDAC7, HEY2, JAG1, LRP1, NPHS2, PLA2G2A, SPP1, TIE1, VPS26A, ZFPM2</i>
Cardiovascular Disease, Developmental Disorder, Hereditary Disorder, Organismal Injury and Abnormalities	Tetralogy of Fallot	1.0×10^{-4}	3	<i>HEY2, JAG1, ZFPM2</i>
Gastrointestinal Disease, Hepatic System Disease, Organismal Injury and Abnormalities	Congestion of liver	1.2×10^{-4}	2	<i>ENG, HEY2</i>
Connective Tissue Disorders, Skeletal and Muscular Disorders	Arthropathy	1.3×10^{-4}	29	<i>AIF1, ARIH1, ART1, ATF6B, C4A/C4B, CYP19A1, DHX16, EGFL8, G0S2, GABRA4, HDAC7, HPGD, LRP1, MICA, MMP16, MSH5, PLA2G2A, PRRC2A, RNF39, SCN9A, SPP1, STAT6, STK19, TIE1, TNXB, TRIM26, TSPO, UFL1, WNT5A</i>
Immunological Disease	Systemic autoimmune syndrome	2.0×10^{-4}	30	<i>ABCF1, AIF1, ARIH1, ART1, ATF6B, C4A/C4B, C6orf48, CYP19A1, DHX16, EGFL8, G0S2, GABBR1, GABRA4, HDAC7, HSD11B1, IKZF3, MICA, MOG,</i>

				<i>MSH5, PLA2G2A, PRRC2A, RNF39, SPP1, STAT6, STK19, TNXB, TRIM26, TSPO, UFL1, WNT5A</i>
Connective Tissue Disorders, Inflammatory Disease, Skeletal and Muscular Disorders	Arthritis	2.3×10^{-4}	28	<i>AIF1, ARIH1, ART1, ATF6B, C4A/C4B, CYP19A1, DHX16, EGFL8, G0S2, GABRA4, HDAC7, LRP1, MICA, MMP16, MSH5, PLA2G2A, PRRC2A, RNF39, SCN9A, SPP1, STAT6, STK19, TIE1, TNXB, TRIM26, TSPO, UFL1, WNT5A</i>
Cancer, Tumor Morphology	Mass of tumor	2.6×10^{-4}	3	<i>ENG, JAG1, TGFA</i>
Cardiovascular Disease, Developmental Disorder	Patent ductus arteriosus	3.4×10^{-4}	3	<i>HPGD, PLA2G2A, TFAP2B</i>
Endocrine System Disorders, Gastrointestinal Disease, Immunological Disease, Metabolic Disease	Insulin-dependent diabetes mellitus	3.5×10^{-4}	16	<i>ABCF1, AIF1, C6orf48, DHX16, GABBR1, HSD11B1, IKZF3, MICA, MOG, MSH5, PRRC2A, RNF39, STAT6, STK19, TNXB, TRIM26</i>
Protein Synthesis	Quantity of prolactin (PRL) in blood	5.3×10^{-4}	3	<i>CORT, CYP19A1, GABBR1</i>
Connective Tissue Disorders, Inflammatory Disease, Skeletal and Muscular Disorders	Rheumatic Disease	6.3×10^{-4}	29	<i>AIF1, ARIH1, ART1, ATF6B, C4A/C4B, CYP19A1, DHX16, EGFL8, G0S2, GABRA4, HDAC7, LRP1, MICA, mir-10, MMP16, MSH5, PLA2G2A, PRRC2A, RNF39, SCN9A, SPP1, STAT6, STK19, TIE1, TNXB, TRIM26, TSPO, UFL1, WNT5A</i>
Cardiovascular System Development and Function, Cell Morphology, Embryonic Development	Branching morphogenesis of vasculature	6.5×10^{-4}	3	<i>APH1A, C1GALT1, TIE1</i>
Cardiovascular Disease, Organismal Injury and Abnormalities	Atresia of tricuspid valve	7.0×10^{-4}	2	<i>HEY2, ZFPM2</i>
Behavior	Avoidance	7.0×10^{-4}	2	<i>OPN4, TRPM8</i>
Cancer, Gastrointestinal Disease	Primary gastric cancer	7.0×10^{-4}	2	<i>SPP1, WNT5A</i>
Cancer	Breast or ovarian carcinoma	7.2×10^{-4}	29	<i>ADAMTS8, APH1A, C4A/C4B, C6orf25, CTNNA1, CYP19A1, DTNA, FAM107B, FRYL, GART,</i>

				<i>GOLGB1, GPR20, HOXD3, HSD11B1, IFI27, mir-10, MS4A4A, NFATC4, OXCT2, PAFAH1B2, PSTPIP2, RALY, SPPI, SSC5D, TAGLN, TGFA, TMEM150B, TNXB, ZFPM2</i>
Neurological Disease	Absence seizure	7.7×10^{-4}	4	<i>CA14, GABBR1, GABRA4, TSPO</i>
Neurological Disease	Epileptic encephalopathy	7.7×10^{-4}	5	<i>CA14, GABBR1, GABRA4, SCN9A, TSPO</i>
Endocrine System Disorders, Gastrointestinal Disease, Metabolic Disease	Diabetes mellitus	8.9×10^{-4}	28	<i>ABCF1, AIF1, ATP2A2, C6orf48, CA14, CYP19A1, DHX16, FXYD2, GABBR1, GABRA4, HPGD, HSD11B1, IKZF3, MICA, mir-10, MOG, MSH5, PRRC2A, PSMD11, RNF39, SCN9A, SLC30A8, SPPI, STAT6, STK19, TNXB, TRIM26, TSPO</i>

Table S3. Canonical pathways significantly enriched for genes that overlap between MA and MO

Pathway	P-value	Overlapping Genes
Notch Signaling	7.8×10^{-4}	<i>MFNG, APH1A, HEY2, JAG1</i>
Superpathway of Geranylgeranyldiphosphate Biosynthesis I (via Mevalonate)	3.2×10^{-2}	<i>PLA2G1B, TBXAS1, PLA2G2A</i>
L-carnitine Biosynthesis	3.2×10^{-2}	<i>ALDH9A1</i>
GABA Receptor Signaling	3.7×10^{-2}	<i>GABRA4, GABBR1, ALDH9A1</i>
5-aminoimidazole Ribonucleotide Biosynthesis I	4.3×10^{-2}	<i>GART</i>
Geranylgeranyldiphosphate Biosynthesis	4.3×10^{-2}	<i>FNTB</i>
MIF-mediated Glucocorticoid Regulation	5.0×10^{-2}	<i>PLA2G1B, PLA2G2A</i>

Table S4. Networks significantly enriched for genes that overlap between MA and MO			
Top Diseases and Functions	P-value	# of focus Genes	Genes^a
Cardiovascular Disease, Organismal Injury and Abnormalities, Cardiac Stenosis	1×10^{-51}	27	<i>Ap1, ATF7, ATP2A2, CEP70, Creb, CYP19A1, DLX3, FHL5, GABBR1, GABRA4, GIP, Gpcr, GPN3, GPR20, GPR139, GPR182, HEY2, Histone h3, Histone h4, HOXD3, MAF, MAP3K12, MICA, MSH5, NFkB(complex), PLA2G1B, PLA2G2A, RNA polymerase II, SP1, SPP1, STAT6, STAT5a/b, SUV39H2, TAGLN, USP8</i>
Hereditary Disorder, Neurological Disease, Connective Tissue Disorders	1×10^{-25}	16	<i>ADCK3, AP4B1, AP4M1, AP4S1, BRSK1, C1GALT1, C1GALT1C1, CTNNAL1, FAIM, HSD17B7, HVCN1, IFT81, IFT88, MND1, NEK1, NOX5, POLE, POP4, POP7, PRSS1, RBBP9, RPP14, RPP21, RPP30, RPP38, RPP40, SERPINB8, SH2D3A, SLC29A1, STK10, STK19, STRADA, TEAD3, UBC, ZNF566</i>
Lipid Metabolism, Small Molecule Biochemistry, Molecular Transport	1×10^{-25}	16	<i>ACSBG1, ACSL5, AIF1, APITD1/APITD1-CORT, ARIH1, ATF6B, BRMS1L, C1orf86, CREBZF, CUTC, FRYL, IDI1, IDI2, KIRREL, LCPI, LZTFL1, MBTPS2, MRPS21, NPHS2, PSTPIP2, RMI2, SARS2, SLC27A2, SLC27A3, SLC27A4, SLC27A6, SNTG1, STX2, STXBP3, SUV420H2, TTC8, TLLI2, UBC, UFL1, USP44</i>
Cellular Movement, Connective Tissue Development and Function, Amino Acid Metabolism	1×10^{-25}	16	<i>ALDH16A1, ALDH3B1, ALDH3B2, ALDH4A1, ALDH7A1, ALDH9A1, APBB1IP, ARPC3, ARPC1A, ARPC5L, CORO1B, DFFA, DHX16, DLGAP1, GMFB, GOLGB1, INPP5A, INPP5B, KIAA1671, NAP1L5, PARVG, RAB13, RAB11FIP4, RAB11FIP5, SLC19A1, SPI00, STRN3, SWAP70, TFAP2B, TRABD2B, TRIM26, UBC, WNT10B, WNT5A, WNT5B</i>
Cellular Assembly and Organization, Cancer, Endocrine System Disorders	1×10^{-24}	16	<i>ACAN, ADAM20, ADAMTS8, ATP5C1, C6orf25, CA14, CCM2L, CDK5R1, CORT, CTAGE1, DLG4, DNAJAI, DNAJC22, DQX1, GPR89A/GPR89B, HSPA8, KLHDC8B, MARCH10, MITF, MPZL1, NME9, NPFF, PLEKHH3, PTPN11, SATB1, SSTR2, SUMO4, TGFA, TIE1, UBC, USP35, USP40, USP50, WFDC3, ZNF337</i>
Post-Translational Modification, Endocrine System Disorders, Hereditary Disorder	1×10^{-21}	14	<i>AAAS, CFTR, CHD3, CHURC1-FNTB, CLCCI, CLOCK, ESYT1, ESYT2, ESYT3, FAM216A, GAN, ISG15, KDM1A, KIAA0922, NAE1, NAT14, NPHP4, PGR, PRKACA, RABAC1, RAD23A, RAD23B, RMDN2, RNF39, RPA3, SLC45A4, TBATA, TMEM194A, TRMT5, UBA3, UBC, UBE2F, UBE2M, UIMC1, ZNF260</i>

Hematological Disease, Molecular Transport, Cancer	1×10^{-21}	14	<i>ANXA2R, BTAFL1, BTF3L4, CCNT2, DNAJB9, DNAJC14, DNAJC15, DUSP11, EAF2, ELAVL1, ELL3, FAM71C, FKBP9, GART, GLTSCR1L, KCTD9, LSM11, LSM14A, MTMR4, MTMR9, NELFA, PPTC7, PRR3, PTPLB, SLC11A2, SLC38A6, SLC48A1, SNRNP48, TBC1D5, TCEA2, VPS29, VPS26A, VPS26B, WDR47, ZCRB1</i>
Developmental Disorder, Organismal Injury and Abnormalities, Reproductive System Disease	1×10^{-21}	14	<i>ALOX15B, AMHR2, AR, C12orf76, C4A/C4B, C5AR2, CCND1, CCRN4L, CDC40, DEPDC1, F2RL3, FFAR1, GPR125, GPR182, GPRC5A, INSM2, KCNMB1, KHDRBS1, KISS1R, MANBA, Muc1, NCOA1, p160, POU5F2, PPARG, PSMC3IP, PTPN21, RALY, SPATA13, SRC, SUZ12, TBXA2R, TBXAS1, TM7SF2, TRPM8</i>
Energy Production, Kidney Failure, Organismal Injury and Abnormalities	1×10^{-21}	14	<i>ABCF1, ALKBH6, APH1A, ARL17A/ARL17B, ATP1A1, ATP1B1, CHD4, DTNA, FAM107B, FNTB, FUK, FUT6, FUT10, FXYD2, HDAC7, HHLA2, HNF1A, HNF4A, HSD11B1, IKZF2, IKZF3, INTS5, MRO, PAFAH2, POLR2A, PRR13, SLC26A1, SLC38A4, SLX4IP, SUMO2, TMEM140, UTP11L, ZBTB45, ZNF155, ZNF300</i>
Inflammatory Disease, Inflammatory Response, Respiratory Disease	1×10^{-20}	14	<i>acetylcholine, ADAM8, ASTN2, CHRNA2, CHRNA4, CHRNA6, CHRNA9, CHRNA10, CHRN1, CHRN2, CHRN3, CHRND, CHRNE, CHRNG, EGFL8, ENG, IRF2BP2, ME1, MIR155HG, MS4A4A, MTMR11, PIGF, PRDM1, PRRC2A, PSMD11, RAD9B, RPS27, SIRT4, SSR3, ST14, TCTN1, TIMM8B, TP53, TSPO, ZFP36</i>
Cell Cycle, Cell Death and Survival, Cellular Assembly and Organization	1×10^{-20}	14	<i>ANKRD13D, APBB2, APBB3, APP, CDCA2, CIART, DNAJC4, EGFR, FBLIM1, FILIP1, FXYD6, ganglioside GD1a, ganglioside GM2, ganglioside GT1, GLB1L, HPGD, HSF1, JAG1, LRPI, LYRM7, MMP16, MMP17, NUDT9, PHACTR4, PP2D1, PPPICC, PPP1R10, PPP1R32, PPP1R14B, PROM2, PRR16, RAB5C, RIN2, SH3BGRL3, SSH3</i>
Cellular Development, Skeletal and Muscular System Development and Function, Tissue Development	1×10^{-16}	12	<i>ANKRD13A, ARHGAP20, ASCC1, CNTN1, ECM2, EDIL3, ELF1, FXN, G0S2, IFI27, LMOD1, mir-133, mir-143, mir-145, MYL4, MYLPF, MYOCD, NFATC4, NOM1, PAFAH1B2, PASK, PPP1CA, PPP1R18, PPP1R12C, PTPN7, SCN9A, SLC7A14, SMARCA4, SMOOTH MUSCLE ACTIN, SPOCD1, SRF, SRFBP1, TMOD3, Ubiquitin, ZNF628</i>
Cell Signaling, Molecular Transport, Vitamin and Mineral Metabolism	1×10^{-16}	12	<i>ABLI, ADORA3, ADRBK1, BMP8B, BRINP1, CCR8, CELSR3, CHRD, COG3, DCLRE1C, EIF5A2, FPR1, FREM2, GIPR, GIT2, GPR45, GRPR, HDAC1, HRH1, HRH2, LTB4R, MDM2,</i>

			<i>NACC2, NPY1R, OPN4, OPRD1, PCBP2, RRBP1, Skor1, ST5, STON2, TACR1, TARBP2, TGIF2, ZFPM2</i>
Hematological Disease, Hereditary Disorder, Organismal Injury and Abnormalities	1×10^{-16}	12	<i>AGO2, ANAPC7, ARFGAP3, ART1, C6orf48, Cbp/p300-Hd-Taf4-Taf9b-Tbp, DPF3, EP300, HOXA10, HOXD4, HTT, Laminin, MFNG, mir-10, miR-100-5p (and other miRNAs w/seed ACCCGUA), miR-10a-5p (and other miRNAs w/seed ACCCUGU), MOG, NDUFA3, NFkB (family), p300-CBP, PARP, PARP3, PARP4, PARP6, PARP8, PARP11, PARP15, PARP16, REG3A, RELA, SEPP1, SSC5D, TIPARP, TNXB, TRIP10</i>
^a Focus genes (overlapping MA and MO) are shown in bold.			

Table S5. Networks constructed by combining significant canonical pathways and biological functions			
Top Diseases and Functions	P-value	Focus Genes	Genes^a
Carbohydrate Metabolism, Lipid Metabolism, Molecular Transport	1×10^{-32}	14	<i>Acot1, ACOX2, ATF6B, BAAT, BMP5, ENG, FAM107B, FNTB, G0S2, HNF4A, HNF4A±dimer, HOXA10, HSD11B1, JAG1, LGALS1, LR1, MECR, MFNG, MMP14, MMP15, MMP16, MMP17, MMP26, MS4A4A, PLA2G12B, PLA2G1B, PLA2G2A, PLA2G2D, PRDM1, PZP, RXRA, sPla2, SSC5D, TNXB, TRPM8</i>
Cellular Movement, Connective Tissue Development and Function, Amino Acid Metabolism	1×10^{-32}	13	<i>ALDH16A1, ALDH1B1, ALDH3B1, ALDH3B2, ALDH4A1, ALDH7A1, ALDH9A1, ARIH1, DHX16, GART, GOLGB1, IFI27, IFI44, MAGEL2, MAN2C1, MRPL13, MTPAP, NDUFA1, NFATC4, PAFAH1B2, PRRC2A, PSMD11, RALY, SLC19A1, TBXAS1, TFAP2B, TRABD2B, TRIM26, UBC, UBLCP1, VPS26A, VPS26B, WNT10B, WNT5A, WNT5B</i>
Connective Tissue Disorders, Neurological Disease, Organismal Injury and Abnormalities	1×10^{-25}	14	<i>ADRBK1, AIFI, CIGALT1, CIGALT1C1, C6orf25, CORT, CTNNAL1, EMR2, FAIM, FRYL, GPR107, GPR108, GPR115, GPR126, GPR155, GPR176, GPR89A/GPR89B, HEATR6, MTMR8, NPHS2, NT5C, NUDT11, OPN4, PGAM4, PPAPDC2, PPTC7, PSTPIP2, PTPN11, RNF39, SSTR2, STK19, THTPA, TPTE, UBC, UFL1</i>
Neurological Disease, Behavior, Immunological Disease	1×10^{-23}	13	<i>ABCF1, ACAN, ADAMTS8, APP, CA14, cholesterol, EGFL8, ETV4, GABBR1, GABRA4, Gpcr, GPR20, GPR62, GPR75, GPR97, GPR110, GPR111, GPR144, GPR152, GPR156, GPR157, GPR162, GPR171, GPR174, GPRC5D, GPRC6A, HDAC7, HOXD4, HPGD, HTT, IKZF3, MITF, MOG, TIMM8B, TSPO</i>
Cardiovascular System Development and Function, Organ Morphology, Skeletal and Muscular System Development and Function	1×10^{-22}	12	<i>ACP5, AHSP, ATP2A2, BTG3, CD69, CYP19A1, DUSP16, ESRRA, HAND1, HEY2, HIST1H3C, Histone h3, Histone h4, HOXD3, HPSE, ID1, IL9, KIR3DL1, LRWD1, MICA, MSH5, Mx1/Mx2, NFκB (complex), Pln, PSG5, REL/RELA/RELB, Scd2, SLN, SPPI, STAT6, TACC2, TAGLN, TIE1, TNFRSF4, ZFPM2</i>
Molecular Transport, Organ Morphology, Skeletal and Muscular System Development and Function	1×10^{-7}	5	<i>ANK3, APHIA, APH1B, ATP1A1, ATP1A2, ATP1A3, ATP1B1, ATP1B2, ATP1B3, D1Pas1, DTNA, DUSP2, EPCAM, FXYD1, FXYD2, FXYD7, KCNJ10, KCNJ12, MAGEE1, MAPK3, MAPK4, MLC1, MTMR2, Na-k-atpase, PTPN7, SCN1A, SCN4A, SCN9A, SLC15A1, SNTA1, SNTB1, SNTB2, TGFA, voltage-gated sodium channel, YME1L1</i>

^a Focus genes (overlapping MA and MO) are shown in bold.