SUPPORTING INFORMATION

SUPPLEMENTARY TABLE INFORMATION

Table S1. 74 genes in cell efferocytosis-related.

id
P2RY2
PGE2
PANX1
STAB2
ADGRB1
TIM4
TYRO3
MERTK
AXL
ELMO1
ELMO2
ELMO3
DOCK1
DOCK2
DOCK3
DOCK4
DOCK5
RAC1
CD47
SIRPA
SLC2A1
SLC16A2
ADAM17
ADAM10
DNASE1
DNASE1L1
DNASE2
PPARG
TIM3
ADAM9
MBTPS1
HIF1A
ARNT
EPO
TNF
TNFR

LRP1
ABCA1
SLC16A1
MCF2
SLC66A1
SGK1
IL10
CCL21
HMBG1
CX3CL1
CX3CR1
CXCR4
P2RY12
P2RY6
P2RX7
SLC26A6
SLC35A4
SLC46A1
SLC7A7
SLC14A1
PPARA
NR1H4
SLC25A1
SLC25A10
SLC20A1
UCP2
CPT1A
DNM1L
SLC12A4
SLC6A6
SLC4A7
WNK1
OSR1
SPAK
PDK1
PDK4
ARG1
ODC1

Table S2. Quantitative real time PCR primers.

Primers	Sequence
Forward primer for SLC26A6	GGACCCCTCTGTTATCCCCT
Reverse primer for SLC26A6	ATGTTCCTAGCACTTGGCCC
Forward primer for TYRO3	CAAGGGACCAACTGGGATCC
Reverse primer for TYRO3	TAGCTTGAGAGGTAGGCGGT
Forward primer for PDK4	GTTCACTTTGCTGCTGAGCC
Reverse primer for PDK4	CAGGATTCGGTCACACCACA
Forward primer for GAPDH	TAGGCAGCAGCAAGCATTCC
Reverse primer for GAPDH	ACGAAGCCCTTCCAGGAGAA

Table S3. Gene Set Enrichment Analysis (GSEA) of distinct risk groups within TCGA-LIHC dataset.

ID	Description	setSize	enrichmentScore	NES	pvalue	p.adjust	qvalue	rank	leading_edge	core_enrichment
KEGG_DRUG_METABOLISM_CYTOCHROME_P450	KEGG_DRUG_METABOLISM_CYTOCHROME_P450	60	-0.7782781515	-2.90653	1e-10	2.6e-09	1.849601538e-09	129	tags=63%, list=9%, signal=58%	FMO5/MAOA/MAOB/GSTA2/ALDH1A3/GSTA1/UGT1A1/CYP2C18/ALDH3A1/UGT2B15/ADH6/CYP2E1/FMO4/AOX1/CYP3A5/ADH1A/FMO3/UGT1A4/CYP2C9/UGT1A3/FMO2/UGT2B10/UGT2B7/GSTZ1/GSTM5/UGT2B17/CYP3A43/ADH1C/ADH4/CYP3A4/ADH1B/CYP2C8/CYP2A6/GSTM1/CYP1A2/CYP2B6/CYP2A7/CYP2A13
KEGG_COMPLEMENT_AND_COAGULATION_CASCADES	KEGG_COMPLEMENT_AND_COAGULATION_CASCADES	68	-0.7534138088	-2.86718	1e-10	2.6e-09	1.849601538e-09	195	tags=69%, list=13%, signal=60%	C4BPB/C5/C8G/PLAT/C4A/SERPINF2/C4B/A2M/CD55/SERPINA5/FGG/PROS1/PROC/FGA/F5/F7/MASP2/FGB/CFH/F2/SERPIND1/BDKRB2/C3/F8/C9/CFI/C1R/F13B/C1S/MBL2/SERPING1/THBD/MASP1/C8B/VWF/F12/KNG1/C4BPA/CPB2/F11/KLKB1/SERPINC1/C8A/PLG/C6/F9/C7
KEGG_RETINOL_METABOLISM	KEGG_RETINOL_METABOLISM	53	-0.7728710663	-2.79891	1e-10	2.6e-09	1.849601538e-09	92	tags=55%, list=6%, signal=52%	UGT1A1/CYP2C18/UGT2B15/ADH6/RDH5/CYP3A5/ADH1A/UGT1A4/CYP4A11/CYP2C9/UGT1A3/UGT2B10/UGT2B7/UGT2B17/RDH16/CYP4A22/CYP1A1/CYP3A43/ADH1C/ADH4/CYP3A4/ADH1B/CYP2C8/CYP2A6/CYP1A2/CYP2B6/CYP2A7/CYP26A1/CYP2A13

KEGG_FATTY_ACID_METABOLISM	KEGG_FATTY_ACID_METABOLISM	41	-0.7912792	2.6796911	1e-10	2.6e-09	1.8496240 6015038e-09	17	tags=73%, list=11%, signal=65%	ACADS/HADHB/ECI2/ECHS1/ALDH9A1/ALDH1B1/ACSL5/HADH/ALDH7A1/CPT2/ACADSB/CPT1A/ACOX1/ACAT1/ACAA1/ADH6/ACADM/GCDH/ALDH2/ACSL6/ACAA2/ADH1A/ACSL1/ACADL/CYP4A11/EHHADH/CYP4A22/ADH1C/ADH4/ADH1B
KEGG_METABOLISM_OF_XENOBIOTICS_BY_CYTOCHROME_P450	KEGG_METABOLISM_OF_XENOBIOTICS_BY_CYTOCHROME_P450	57	-0.7140595	2.6328622	1e-10	2.6e-09	1.8496240 6015038e-09	11	tags=53%, list=8%, signal=49%	EPHX1/GSTA2/ALDH1A3/GSTA1/UGT1A1/CYP2C18/ALDH3A1/UGT2B15/ADH6/CYP2E1/CYP3A5/ADH1A/UGT1A4/CYP2C9/UGT1A3/UGT2B10/UGT2B7/GSTZ1/GSTM5/UGT2B17/CYP1A1/CYP3A43/ADH1C/ADH4/CYP3A4/ADH1B/CYP2C8/GSTM1/CYP1A2/CYP2B6
KEGG_PEROXISOME	KEGG_PEROXISOME	78	-0.6646601	2.5916891	1e-10	2.6e-09	1.8496240 6015038e-09	25	tags=56%, list=17%, signal=47%	PEX14/PAOX/PEX13/PEX7/IDH1/SOD2/NUDT12/HACL1/PEX12/PEX3/PEX11A/PEX1/CRAT/GSTK1/PHYH/HMGCL/SOD1/DHRS4/ECI2/PECR/HSD17B4/ACSL5/PIPOX/AMACR/ACOX2/ACOX1/ACAA1/PXMP2/MLYCD/PEX11G/NOS2/CAT/BAAT/AGXT/ACSL6/ACSL1/SCP2/EPHX2/SLC27A2/DAO/HAO1/EHHADH/HAO2/XDH
KEGG_TRYPTOPHAN_METABOLISM	KEGG_TRYPTOPHAN_METABOLISM	35	-0.7805985	2.5814229	1e-10	2.6e-09	1.8496240 6015038e-09	12	tags=66%, list=8%, signal=60%	MAOA/ECHS1/ALDH9A1/MAOB/ALDH1B1/HADH/ALDH7A1/ACAT1/ACMSD/HAAO/GCDH/TDO2/ALDH2/CAT/AOX1/OGDHL/KMO/INMT/EHHADH/AADAT/CYP1A1/IDO2/CYP1A2

KEGG_PPAR_SIGNALING_PATHWAY	KEGG_PPAR_SIGNALING_PATHWAY	62	-0.64326510 7	-2.40056 3	2.284 6077 7695 082e-09	5.197 4826 9256 312e-08	3.697 4573 2322 304e-08	1 5 2 5	tags=50%, list=10%, signal=45%	PPARA/APOA1/LPL/ACSL5/PLIN1/CYP27A1/CPT2/CPT1A/ACOX2/ACOX1/ACAA1/ANGPTL4/ACADM/APOC3/HMGCS2/ACSL6/CYP7A1/ACSL1/APOA5/SCP2/PCK2/ACADL/SLC27A2/CYP4A11/EHHADH/RXRG/PCK1/CYP4A22/SLC27A5/CYP8B1/FABP4
KEGG_VALINE_LEUCINE_AND_ISOLEUCINE_DEGRADATION	KEGG_VALINE_LEUCINE_AND_ISOLEUCINE_DEGRADATION	43	-0.71776679	-2.45508 1	2.700 2122 2660 455e-09	5.460 4291 6935 586e-08	3.884 5158 3476 443e-08	2 4 4 7	tags=84%, list=16%, signal=70%	DLD/ALDH3A2/HMGCS1/MCCC1/ACAD8/AUH/MCCC2/ACADS/HADHB/HSD17B10/HMGCL/PCCA/PCCB/HIBCH/ECHS1/ALDH9A1/MCEE/DBT/ALDH1B1/HIBADH/HADH/ALDH7A1/BCKDHA/ACADSB/IVD/ACAT1/ACAA1/ACADM/ALDH2/HMGCS2/BCKDHB/AOX1/ACAA2/ABAT/EHHADH/ALDH6A1
KEGG_DRUG_METABOLISM_OTHER_ENZYMES	KEGG_DRUG_METABOLISM_OTHER_ENZYMES	45	-0.70695677	-2.47737 8	3.847 6126 1785 19e-09	7.002 6549 6449 046e-08	4.981 6458 1048 194e-08	1 1 0 0	tags=49%, list=7%, signal=45%	NAT1/CES1/UGT1A1/UGT2B15/UPB1/CES2/DPYS/CYP3A5/UGT1A4/CES5A/UGT1A3/UGT2B10/UGT2B7/UGT2B17/XDH/CYP3A43/CYP3A4/NAT2/CYP2A6/UPP2/CYP2A7/CYP2A13
KEGG_GLYCINE_SERINE_AND_THREONINE_METABOLISM	KEGG_GLYCINE_SERINE_AND_THREONINE_METABOLISM	30	-0.76944759 6	-2.44121 4	2.130 9766 5656 856e-08	3.525 7977 4086 798e-07	2.508 2308 9720 51e-07	2 0 0 2	tags=70%, list=13%, signal=61%	SRR/AOC3/GLDC/GCAT/MAOA/MAOB/GLYCTK/PIPOX/SHMT1/AGXT2/CBS/GATM/ALAS1/SARDH/AGXT/DAO/DMGDH/SDS/GNMT/BHMT/CTH

KEGG_CELL_CYCLE	KEGG_CELL_CYCLE	112	0.55690796549014798	2.06090833599798	3.4398132022e-08	5.2170501 55e-07	3.7113775 471e-07	18 3 5	tags=35%, list=128%, signal=31%	CDC20/SFN/SMC1B/CDC25A/PLK1/CDKN1C/CDC6/BUB1B/PTTG1/ORC6/CCNB1/TTK/ORC1/E2F2/CDK1/CCNB2/BUB1/MCM2/CDC45/CDC7/MCM4/PKMYT1/MAD2L1/CCNE2/MCM6/CDC25C/RBL1/E2F5/CHEK1/CDKN2A/TGFB2/MCM7/YWHAZ/CDC25B/TGFB1/MCM3/ESPL1/E2F1/E2F3/MCM5/CDK4/DBF4
KEGG_STEROID_HORMONE_BIOSYNTHESIS	KEGG_STEROID_HORMONE_BIOSYNTHESIS	44	-0.68937311	-2.38579 6	3.9893981 018e-08	5.5851574 826e-07	3.9732467 103e-07	11 7 8	tags=43%, list=18%, signal=40%	HSD17B8/UGT1A1/UGT2B15/CYP11A1/CYP3A5/CYP7A1/SRD5A1/UGT1A4/UGT1A3/UGT2B10/UGT2B7/HSD17B6/UGT2B17/SRD5A2/CYP1A1/CYP3A43/CYP3A4/HSD11B1/AKR1D1
KEGG_RIBOSOME	KEGG_RIBOSOME	86	0.61363610938266265	2.16306907582926	4.3588097 7007 983e-08	5.6664527 0110 378e-07	4.0310797 1217 91e-07	42 26 3	tags=73%, list=28%, signal=53%	RPL8/RPL36A/RPSA/RPS19/RPL7/RPL23A/RPL38/RPS21/RPLP2/RPL18A/RPL35/RPL14/RPL9/RPS24/RPS2/RPL28/RPL37A/RPL32/RPL27A/RPS3/RPL37/RPS7/RPL35A/RPS5/RPS20/RPL39/RPS10/RPS27A/RPLP0/RPS16/RPL18/MRPL13/RPL22L1/RPL30/RPS8/RPL36/RPL13/RPL7A/RPL6/RPL27/RPS15/RPL23/RPL17/RPL5/RPL29/RPL13A/RPS11/RPL24/RPLP1/RPS12/RPS18/RPS27/RPS3A/RPL12/RPS6/RPL19/RPS23/RPS17/RPL4/RPL31/RPS4X/RPS28/RPS9
KEGG_PROPANOATE_METABOLISM	KEGG_PROPANOATE_METABOLISM	30	-0.74988478 8	-2.37914 7	1.2080484 065e-07	1.4657654 945e-06	1.0427365 214e-06	14 43 6	tags=67%, list=9%, signal=60%	PCCA/PCCB/ACSS3/HIBCH/ECHS1/ALDH9A1/MCEE/SUCLG2/ACACB/ALDH1B1/ALDH7A1/SUCLG2P2/ACAT1/MLYCD/LDHC/ACADM/ALDH2/ABAT/EHHADH/ALDH6A1

KEGG_HISTIDINE_METABOLISM	KEGG_HISTIDINE_METABOLISM	27	-0.75699	-2.36971	1.773e-07	1.898e-06	1.350e-06	15/129/2	tags=63%, list=11%, signal=56%	HNMT/MAOA/ACY3/ALDH9A1/MAOB/HAL/ALDH1B1/ALDH1A3/ALDH7A1/ALDH3A1/FTCD/ASPA/ALDH2/HDC/AMDHD1/UROC1/CNDP1
KEGG_ARGININE_AND_PROLINE_METABOLISM	KEGG_ARGININE_AND_PROLINE_METABOLISM	49	-0.64653	-2.30044	1.700e-07	1.898e-06	1.350e-06	16/133/7	tags=57%, list=11%, signal=51%	AGMAT/ALDH4A1/LAP3/SAT1/ACY1/MAOA/ALDH9A1/NAGS/PRODH2/MAOB/ALDH1B1/GLUL/ALDH7A1/ARG2/ASL/GOT1/GOT2/GATM/NOS2/ASS1/ALDH2/OAT/OTC/CPS1/ARG1/DAO/PRODH/GLS2
KEGG_PRIMARY_BILE_ACID_BIOSYNTHESIS	KEGG_PRIMARY_BILE_ACID_BIOSYNTHESIS	16	-0.86268	-2.35504	1.921e-07	1.943e-06	1.382e-06	18/84/5	tags=88%, list=12%, signal=77%	CYP7B1/CYP46A1/CH25H/HSD17B4/CYP27A1/AMACR/ACOX2/BAAT/CYP7A1/SCP2/CYP39A1/SLC27A5/AKR1D1/CYP8B1
KEGG_TYROSINE_METABOLISM	KEGG_TYROSINE_METABOLISM	32	-0.68671	-2.20038	3.556e-06	3.406e-05	2.423e-04	12/27/2	tags=59%, list=8%, signal=54%	FAH/AOC3/MAOA/MAOB/ALDH1A3/GOT1/ALDH3A1/GOT2/ADH6/HGD/AOX1/ADH1A/HPD/DBH/GSTZ1/ADH1C/ADH4/ADH1B/TAT

KEGG_BUTANOATE_METABOLISM	KEGG_BUTANOATE_METABOLISM	31	-0.660484092	-2.10795745e-05	2.864 5463 7406 425e-05	0.000 2606 7372 0039 847	0.000 1854 4168 6321 002	1 7 0 5	tags=65%, list=11%, signal=57%	ACADS/HMGCL/BDH2/ECHS1/L2HGDH/ALDH9A1/ALDH1B1/BDH1/HADH/ALDH7A1/ACSM1/ALDH5A1/ACAT1/ALDH2/HMGCS2/ACSM3/ABAT/EHHADH/ACSM5/ACSM2A
KEGG_LYSINE_DEGRADATION	KEGG_LYSINE_DEGRADATION	39	-0.600922787	-2.04790143e-05	4.205 0081 1767 143e-05	0.000 3644 3403 6864 858	0.000 2592 5613 9585 758	1 5 6 8	tags=38%, list=10%, signal=35%	SETD7/ECHS1/ALDH9A1/ALDH1B1/HADH/ALDH7A1/PIPOX/ACAT1/GCDH/ALDH2/OGDHL/EHHADH/AADAT/BBOX1/AASS
KEGG_CITRATE_CYCLE_TCA_CYCLE	KEGG_CITRATE_CYCLE_TCA_CYCLE	30	-0.640236223	-2.03801699e-05	8.326 2342 3813 0609 514	0.000 6888 0665 0609 827	0.000 4900 1282 8368 827	3 7 7 8	tags=73%, list=25%, signal=55%	SDHC/IDH2/OGDH/SUCLG1/IDH3A/ACO2/SUCLA2/MDH1/SDHA/DLD/IDH1/DLST/SDHB/FH/SDHD/SUCLG2/PC/ACO1/SUCLG2P2/OGDHL/PCK2/PCK1
KEGG_CYSTEINE_AND_METHIONINE_METABOLISM	KEGG_CYSTEINE_AND_METHIONINE_METABOLISM	32	-0.620412998	-1.99836059985e-05	0.000 1007 7914 5906 376	0.000 7958 5070 9942 172	0.000 5661 6331 5921 846	9 7 9	tags=38%, list=6%, signal=35%	ADI1/GOT1/GOT2/LDHC/CBS/MAT1A/CDO1/SDS/DNMT3L/BHMT/CTH/TAT

			-		0.000	0.000	0.000		tags=4
				-				1	1%,
KEGG_GLYCOLYS	KEGG_GLYCOLYS		0.53		1049	7958	5661		
		5		1.91				2	list=8%
IS_GLUCONEOGE	IS_GLUCONEOGE		596		4734	5070	6331		
		1		590				6	,
NESIS	NESIS		493		6366	9942	5921		
				6				0	signal=
			1		001	172	846		
									38%
									tags=3
			-		0.000	0.000	0.000		
KEGG_PORPHYRI	KEGG_PORPHYRI								1%,
			0.61	-	1293	9416	6698	9	
N_AND_CHLOROP	N_AND_CHLOROP	3							list=6%
			884	1.98	4593	3842	7580	6	
HYLL_METABOLI	HYLL_METABOLI	2							
			749	291	7698	6442	3658	0	,
SM	SM								
			2		214	998	119		signal=
									29%
									tags=4
			-		0.000	0.001	0.001		
				-				1	6%,
KEGG_STARCH_A	KEGG_STARCH_A		0.57		2183	5287	0875		
		3		1.91				3	list=9%
ND_SUCROSE_ME	ND_SUCROSE_ME		009		9735	8145	6575		
		9		637				7	,
TABOLISM	TABOLISM		951		0501	3512	3510		
				5				0	signal=
			1		768	37	83		
									42%
									tags=6
			-		0.000	0.002	0.001		
				-				1	7%,
KEGG_BETA_ALA	KEGG_BETA_ALA		0.68		3212	1652	5403		
		2		1.99				3	list=9%
NINE_METABOLIS	NINE_METABOLIS		118		2007	6123	5357		
		1		060				5	,
M	M		810		3752	7888	0042		
				4				1	signal=
			6		705	6	21		
									61%

	ALDH9A1/ENO3/ALDH1B1/ALDH1A3/PGM2/PGM1/ALDH7A1/PKLR/ALDH3A1/ADH6/LDHC/ALDH2/ADH1A/PCK2/ALDOB/FB
	P1/PCK1/ADH1C/ADH4/ADH1B/GCK
	CP/UGT1A1/ALAD/UGT2B15/ALAS1/UGT1A4/UGT1A3/UGT2B10/UGT2B7/UGT2B17
	AMY2B/PYGL/ENPP1/PGM2/UGT1A1/PGM1/UGT2B15/AGL/UGP2/UGT1A4/UGT1A3/UGT2B10/UGT2B7/UGT2B17/GBA3/TREH/
	GYS2/GCK
	AOC3/HIBCH/ECHS1/ALDH9A1/ALDH1B1/ALDH7A1/MLYCD/ACADM/UPB1/DPYS/ALDH2/ABAT/EHHADH/CNDP1

			-0.490214028383	-1.82964044	0.000376150813321	0.002444980386751109	0.001739344397283905	3	tags=42%, list=21%, signal=34%	
KEGG_ADIPOCYTOKINE_SIGNALING_PATHWAY	KEGG_ADIPOCYTOKINE_SIGNALING_PATHWAY	5						2		PRKAB2/POMC/AKT1/TNFRSF1A/CD36/TNFRSF1B/SOCS3/RXRA/ADIPOR2/NFKBIA/PPARA/IRS1/SLC2A4/ACACB/ACSL5/CPT1A/PRKAG2/IRS2/LEPR/ACSL6/PPARGC1A/ACSL1/PCK2/RXRG/PCK1
			0.61359166596158163591763	1.88731816	0.000456150387937993	0.002862736918099633	0.002036533491033748	2	tags=54%, list=19%, signal=44%	
KEGG_DNA_REPLICATION	KEGG_DNA_REPLICATION	3						8		MCM2/MCM4/MCM6/RFC4/MCM7/DNA2/MCM3/POLD1/FEN1/MCM5/POLA2/RNASEH2A/PRIM1/POLA1/LIG1/PCNA/PRIM2/RFC2/POLD3
		5						7		
								4		
			-0.660765106194869	-1.95104	0.000585395115136969	0.003551371970294894	0.002526487338620423	1	tags=52%, list=8%, signal=48%	
KEGG_LINOLEIC_ACID_METABOLISM	KEGG_LINOLEIC_ACID_METABOLISM	2						2		PLA2G2A/PLA2G5/CYP2C18/CYP2J2/CYP2E1/CYP3A5/CYP2C9/CYP3A43/CYP3A4/CYP2C8/CYP1A2
		1						2		
								0		
			-0.660765071083133	-1.94352	0.000633545431487108	0.003719571951594359	0.002646043467156684	9	tags=48%, list=6%, signal=45%	
KEGG_PENTOSE_AND_GLUCURONATE_INTERCONVERSIONS	KEGG_PENTOSE_AND_GLUCURONATE_INTERCONVERSIONS	2						2		UGT1A1/CRYL1/UGT2B15/UGP2/UGT1A4/UGT1A3/UGT2B10/UGT2B7/DCXR/UGT2B17
		1						0		

KEGG_CARDIAC_MUSCLE_CONTRACTION	KEGG_CARDIAC_MUSCLE_CONTRACTION	54	0.53891737898107295	1.77988828444729244	0.000733727932235826	0.004173077622266517	0.002968796830991824	30	tags=35%, list=20%, signal=28%	TNNC1/TNNT2/CACNG4/FXYD2/MYL3/TPM2/CACNB1/CACNB3/ATP1A3/ATP1B3/CACNA2D2/ATP1A1/CACNA1D/TPM4/SLC9A1/CACNA2D4/COX6B1/CYC1/TPM3
KEGG_INSULIN_SIGNALING_PATHWAY	KEGG_INSULIN_SIGNALING_PATHWAY	126	-0.37487460266	-1.58222286054	0.000874015236	0.008203264644	0.003429191691	14	tags=15%, list=9%, signal=14%	IRS1/PYGL/SLC2A4/ACACB/PDE3B/PKLR/PPP1R3B/PRKAG2/IRS2/PIK3R1/PPARGC1A/PCK2/FOXO1/SOCS2/FBP1/PCK1/GYS2/GCK/SHC4
KEGG_PYRUVATE_METABOLISM	KEGG_PYRUVATE_METABOLISM	37	-0.56089531121	-1.87015206330	0.001034365486	0.005536894400	0.003938914981	12	tags=43%, list=8%, signal=40%	ALDH9A1/ACACB/ACYP2/ALDH1B1/PC/ALDH7A1/PKLR/HAGH/ACAT1/LDHC/GRHPR/ALDH2/LDHD/PCK2/ACOT12/PCK1
KEGG_ASCORBATE_AND_ALDARATE_METABOLISM	KEGG_ASCORBATE_AND_ALDARATE_METABOLISM	19	-0.66636826866	-1.89414346957	0.001400361546	0.007028180001	0.005180278822	12	tags=58%, list=8%, signal=53%	ALDH9A1/ALDH1B1/UGT1A1/ALDH7A1/UGT2B15/ALDH2/UGT1A4/UGT1A3/UGT2B10/UGT2B7/UGT2B17

KEGG_SPLICEOSOME	KEGG_SPLICEOSOME	124	0.42691333633815977	1.58493916838579	0.0018023310066570927	0.0091117845336553591	0.0064820676555211	60	tags=56%, list=40%, signal=34%	SNRPB/SNRPD1/ALYREF/SNRPD2/SF3B4/SNRPA/PPIH/SNRPF/LSM4/SNRPE/SNRPA1/LSM7/PUF60/SF3A2/PPIL1/LSM2/ISY1/NCBP2/PRPF3/SNRPC/EFTUD2/TCERG1/LSM8/SNRNP40/SNRPG/THOC1/PRPF31/U2AF2/TXNL4A/PQBP1/RBM17/PRPF40B/PRPF6/U2SURP/THOC3/CCDC12/SNRPB2/PPIE/SRSF9/HNRNPA3/HSPA6/HNRNPA1/HNRNPA1L2/SNRNP70/ACIN1/RBMX/HNRNPU/RBM8A/PRPF38A/BUD31/USP39/SF3A3/PHF5A/MAGOH/EIF4A3/SNRPD3/SF3B5/SRSF1/HNRNPM/HSPA2/SRSF3/PRPF4/DHX15/DDX39B/SRSF2/DDX23/MAGOHB/THOC2/PRPF38B/PRPF19
KEGG_RENIN_ANGIOTENSIN_SYSTEM	KEGG_RENIN_ANGIOTENSIN_SYSTEM	14	-0.70007525656	-1.83672867709615953	0.0019547699	0.0094991668	0.0067576490	10	tags=29%, list=7%, signal=27%	MME/ENPEP/ACE2/REN
KEGG_ABC_TRANSPORTERS	KEGG_ABC_TRANSPORTERS	39	-0.50897917317	-1.71092397839	0.0019833424	0.0094991668	0.0067576490	95	tags=28%, list=6%, signal=26%	ABCG5/ABCC6/ABCG8/ABCC11/ABCG2/ABCA9/ABCA6/ABCC9/ABCB11/ABCB4/ABCA8
KEGG_ALANINE_ASPARTATE_AND_GLUTAMATE_METABOLISM	KEGG_ALANINE_ASPARTATE_AND_GLUTAMATE_METABOLISM	29	-0.54128409232	-1.70333388083219	0.0034646202	0.0157640229	0.0112144288662	12	tags=55%, list=8%, signal=51%	ALDH4A1/ACY3/GLUL/ASL/GOT1/ALDH5A1/AGXT2/GPT2/GOT2/GPT/ASPA/ASS1/AGXT/CPS1/ABAT/GLS2

			-0.4644208	-1.7815596	0.003751515	0.016653812	0.011846432	tags=34%, list=9%, signal=36%	
KEGG_ARACHIDONIC_ACID_METABOLISM	KEGG_ARACHIDONIC_ACID_METABOLISM	4 6 925 5	-0.4609256	-1.6508605	0.004420172	0.022357239	0.028862132	tags=31%, list=9%, signal=36%	GGT5/PTGS2/PLA2G2A/CYP2U1/CBR1/PLA2G5/PTGIS/CYP2C18/CYP2J2/CYP4F3/CYP2E1/EPHX2/CYP4A11/CYP2C9/CYP4F2/CYP4A22/CYP2C8/CYP2B6
KEGG_HOMOLOGOUS_RECOMBINATION	KEGG_HOMOLOGOUS_RECOMBINATION	2 5 450	0.6320819	1.7815596	0.003751515	0.016653812	0.011846432	tags=44%, list=19%, signal=36%	RAD54L/EME1/XRCC2/RAD51/BLM/RAD54B/POLD1/XRCC3/BRCA2/RAD51D/POLD3
KEGG_NEUROACTIVE_LIGAND_RECEPTOR_INTERACTION	KEGG_NEUROACTIVE_LIGAND_RECEPTOR_INTERACTION	1 3 068 0 937 8	-0.3406925	-1.4186923	0.005279829	0.023954529	0.017041152	tags=26%, list=11%, signal=24%	GRID1/NR3C1/P2RY14/PTGDR/SSTR1/PTH2R/APLNR/F2/ADRB1/BDKRB2/ADRA2B/S1PR1/CALCRL/P2RX3/GRM2/EDNRB/ADRB2/PTH1R/F2RL3/LEPR/GRIN2B/CHRNA4/ADRA1B/PLG/GRPR/NPY1R/AVPR1A/GHR/HTR2B/GABBR2/VIPR1/GCGR/DRD1/ADRA1A
KEGG_PRION_DISEASES	KEGG_PRION_DISEASES	3 3 151 4	-0.5112504	-1.6508605	0.007041966	0.029538512	0.021032017	tags=36%, list=13%, signal=32%	C5/C8G/IL6/SOD1/FYN/C9/EGR1/NCAM2/C8B/C8A/C6/C7

KEGG_NOD_LIKE_RECEPTOR_SIGNALING_PATHWAY	KEGG_NOD_LIKE_RECEPTOR_SIGNALING_PATHWAY	56	0.48110651868945273	1.59906767270687	0.0075000265753480144	0.0310228371980304	0.0226940617456191	36	tags=32%, list=24%, signal=24%	CXCL1/MAPK13/PYCARD/CXCL8/IL18/MAPK12/TNF/RIPK2/CCL13/IL1B/CARD9/BIRC3/PSTPIP1/HSP90AB1/CCL8/MAPK3/MAPK10/NOD2
KEGG_BIOSYNTHESIS_OF_UNSATURATED_FATTY_ACIDS	KEGG_BIOSYNTHESIS_OF_UNSATURATED_FATTY_ACIDS	20	-0.58393990595	-1.67297	0.0097278531153	0.0384885623211	0.0273805456191	30	tags=60%, list=20%, signal=48%	HSD17B12/HADHA/ELOVL6/ELOVL5/ELOVL2/ACOT4/ACOT1/ACOT2/PECR/ACOX1/ACAA1/BAAT
KEGG_GLYCOSPHINGOLIPID_BIOSYNTHESIS_LACTO_AND_NEOLACTO_SERIES	KEGG_GLYCOSPHINGOLIPID_BIOSYNTHESIS_LACTO_AND_NEOLACTO_SERIES	22	0.59497589334825256	1.63691643545756	0.0096909644515356	0.0384885623211	0.0273805456191	134	tags=41%, list=9%, signal=37%	FUT3/B3GALT2/B3GNT3/FUT2/FUT4/FUT7/B3GNT4/FUT1/ST8SIA1
KEGG_ETHER_LIPID_METABOLISM	KEGG_ETHER_LIPID_METABOLISM	23	0.57188366092091913	1.57958850180632	0.0114750440471100	0.0444352769216	0.0316109398358	112	tags=30%, list=7%, signal=28%	PAFAH1B3/LPCAT1/ENPP6/PLA2G2D/PLA2G7/PLA2G1B/LPCAT4

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26 **Table S4.** Hallmark analyzed a table of 18 channels.

ID	Description	setSize	enrichmentScore	NES	pvalue	p.adjust	qvalue	rank	leading_edge	core_enrichment
HALLMARK_BILE_ACID_METABOLISM	HALLMARK_BILE_ACID_METABOLISM	109	-0.667840078	-2.768347983	1e-10	1e-09	5.47368421052632e-10	2397	tags=63%, list=16%, signal=54%	PAOX/PEX13/PEX7/IDH1/RXRA/FDXR/NUDT12/HACL1/PNPLA8/PEX12/ALDH1A1/ISOC1/CYP7B1/HSD17B11/LIPE/RETSAT/PEX11A/PEX1/DIO1/GSTK1/PHYH/SOD1/CYP46A1/APOA1/NEDD4/CH25H/SLC23A2/PECR/ALDH9A1/GC/HSD17B4/ACSL5/NR3C2/SERPINA6/PIPOX/CYP27A1/LONP2/AMACR/ABCG8/PXMP2/MLYCD/SLCO1A2/PEX11G/ABCA9/CAT/AGXT/AR/CYP7A1/ACSL1/ABCA6/SCP2/EPHX2/SLC27A2/AQP9/ALDH8A1/HAO1/NR1I2/TTR/HSD17B6/RXRG/GNMT/SULT1B1/BBOX1/DIO2/CYP39A1/ABCA8/SLC27A5/AKR1D1/CYP8B1
HALLMARK_XENOBIOTIC_METABOLISM	HALLMARK_XENOBIOTIC_METABOLISM	191	-0.606663402	-2.693687494	1e-10	1e-09	5.47368421052632e-10	1866	tags=52%, list=12%, signal=46%	FAH/PTGR1/GCLC/RETSAT/MCCC2/VTN/HNF4A/CDA/ID2/TMBIM6/ETS2/IGFBP4/PDLIM5/SAR1B/PROS1/BPHL/MAOA/TMEM176B/ABHD6/ALDH9A1/CA2/PAPSS2/EPHX1/CBR1/ITIH1/ANGPTL3/PC/CES1/SLC35D1/CYFIP2/GCKR/ACSM1/LPIN2/ARG2/ASL/SERPINA6/TTPA/CYP27A1/LEAP2/IGF1/POR/ENTPD5/CYP2C18/CSAD/ACOX2/ACOX1/CYP2J2/ALDH3A1/GCH1/PEMT/PINK1/FAS/PGRMC1/NDRG2/MBL2/UPB1/DHRS1/CYB5A/ALAS1/CYP2E1/ATOH8/HGFAC/RBP4/TDO2/ETFDH/ALDH2/LCAT/CAT/ENPEP/GABARAPL1/AOX1/CDO1/IGFBP1/F11/FETUB/FMO3/SLC6A12/ARG

HALLMARK_FATTY_ACID_METABOLISM	HALLMARK_FATTY_ACID_METABOLISM	146	-0.60521	-2.61715	1e-10	1e-09	5.47368 421052 632e-10	25	tags=56%, list=17%, signal=47%	1/HRG/AQP9/SLC46A3/MTHFD1/PLG/DCXR/MT2A/GNMT/CYP4F2/FBP1/XDH/CYP1A1/ADH1C/HSD11B1/CCL25/CYP1A2/ESR1/TAT/PDK4/SLC22A1/CYP26A1 PCBD1/PTS/SDHA/ELOVL5/DLD/IDH1/RDH11/ALDH3A2/HMGCS1/ADIPOR2/DLST/ALDH1A1/DECR1/TP53INP2/AUH/CRYZ/HSD17B11/AQP7/RETSAT/AOC3/FH/ACADS/HADHB/CRAT/HSDL2/HSD17B10/REEP6/PPARA/HMGCL/SERINC1/ACOT2/ECI2/HIBCH/BPHL/MAOA/ECHS1/ALDH9A1/MCEE/HPGD/G0S2/SDHD/CA2/EPHX1/SUCLG2/CBR1/ENO3/HSD17B4/ACSL5/GLUL/HADH/CPT2/CPT1A/ACOX1/ALDH3A1/ALAD/ACAA1/CD1D/MLYCD/ACADM/GCDH/TDO2/ETFDH/GRHPR/HMGCS2/BCKDHB/GABARAPL1/ACAA2/ACSM3/ACSL1/ACADL/INMT/CYP4A11/EHHADH/GSTZ1/GPD1/HAO2/AADAT/RDH16/CYP4A22/CYP1A1/ADH1C/CA4
HALLMARK_E2F_TARGETS	HALLMARK_E2F_TARGETS	195	0.60484 49976 29638	2.53687 95702 62	1e-10	1e-09	5.47368 421052 632e-10	345	tags=58%, list=23%, signal=46%	MYBL2/CDC20/KIF2C/TRIP13/AURKB/CDC25A/CENPM/PLK1/KIF18B/BIRC5/HMGA1/BUB1B/KIF4A/PTTG1/CDCA3/ORC6/GINS1/TOP2A/CDK1/CDCA8/MKI67/DLGAP5/CCNB2/ASF1B/SPC25/TACC3/CENPE/UBE2T/UBE2S/MCM2/HELLS/DEPDC1/MELK/CDKN3/CKS2/MCM4/PSMC3IP/MAD2L1/DSCC1/RACGAP1/EZH2/LMNB1/MCM6/NCAPD2/KPNA2/RRM2/PLK4/CHEK1/SPC24/TCF19/NOP56/BARD1/CDKN2A/GINS4/MCM7/SNRPB/STMN1/CIT/RAD51AP1/CDC25B/MCM3/ESPL1/TK1/NME1/POLD1/HMMR/NAP1L1/E2F8/DDX39A/SPAG5/MXD3/BRCA1/MCM5/CDK4/POLA2/TUBG1/DNMT1/MMS22L/HMGB2/RNASEH2A/TUBB/MSH2/AURKA/LIG1/RAN/CCNE1/BRCA2/SMC4/CKS1B/PCNA/PRKDC/GINS3/PA2G4/TIPIN/CSE1L/CBX5/PRIM2/RFC2/POLD3/DONSON/RAD21/ATAD2/

HALLMARK_G2M_CHECKPOINT	HALLMARK_G2M_CHECKPOINT	187	0.6511488476046026	2.5280395699726	1e-10	1e-09	5.47368421052632e-10	24/31	tags=47%, list=16%, signal=40%	TIMELESS/NASP/MTHFD2/SLBP/ILF3/LYAR/NUP107/USP1/DCTPP1/POP7/EED/LBR EFNA5/MYBL2/CDC20/UBE2C/KIF2C/AURKB/CDC25A/CENPA/PLK1/BIRC5/CDC6/RAD54L/TROAP/HMGA1/KIF23/KIF4A/PTTG1/ORC6/CENPF/KIF15/TTK/TOP2A/SLC38A1/E2F2/CDK1/MKI67/NEK2/CCNB2/BUB1/TPX2/TRAIP/EXO1/KIF11/TACC3/CENPE/NDC80/UBE2S/MCM2/POLQ/CDC45/CDC7/CCNF/CDKN3/CKS2/STIL/MAD2L1/RACGAP1/PBK/EZH2/LMNB1/MCM6/KPNA2/SLC7A1/PRC1/UCK2/PLK4/RBL1/CHEK1/BARD1/NUSAP1/STMN1/DTYMK/MARCKS/CDC25B/TGFB1/MCM3/ESPL1/E2F1/E2F3/HMMR/SNRPD1/DDX39A/MCM5/CDK4/POLA2/DBF4/KIF20B/FBXO5/GINS2/CBX1/AURKA/MTF2/BRCA2/INCENP/MEIS2/SMC4/CKS1B/SLC7A5
HALLMARK_COAGULATION	HALLMARK_COAGULATION	128	-0.4943393996	-2.0991231552	1.60179448999975e-07	1.33482874166645e-06	7.30643100701638e-07	19/05	tags=43%, list=13%, signal=38%	APOC1/C8G/PLAT/RAPGEF3/A2M/GDA/PECAM1/HNF4A/CLU/FBN1/APOA1/FGG/HPN/MST1/DPP4/PROS1/PROC/TF/FGA/TMPRSS6/MASP2/ITIH1/CFH/F2/ITGB3/C3/FYN/F8/C9/ACOX2/CFI/CTSO/C1R/ANG/RGN/F13B/C1S/MBL2/SERPING1/THBD/TIMP3/C8B/VWF/F12/APOC3/HMGCS2/CPB2/F11/KLKB1/HRG/PROZ/SERPINC1/C8A/PLG/F9
HALLMARK_OXIDATIVE_PHOSPHORYLATION	HALLMARK_OXIDATIVE_PHOSPHORYLATION	183	-0.4306277	-1.8668661 78	3.63700436188 53e-07	2.59786025848 95e-06	1.42198666780478e-06	34/30	tags=33%, list=23%, signal=26%	GLUD1/NDUFB6/SUCLG1/UQCR11/AFG3L2/IDH3A/ACO2/ECI1/ISCA1/SUCLA2/NDUFS7/MDH1/SURF1/HADHA/SLC25A4/ECH1/ABCB7/AIFM1/OPA1/ACADVL/SDHA/MRPL34/DLD/PRDX3/IDH1/NDUFS1/FXN/DLST/DECR1/UQCRC2/RETSAT/NDUFA5/SDHB/FH/HADHB/PHYH/HSD17B10/MPC1/BDH2/SLC25A20/ECHS1/FDX1/ETFA/NNT/SDHD/MAOB/BCKDHA/ACADSB/POR/CPT1A/ACA

HALLMARK_ADIPOGENESIS	HALLMARK_ADIPOGENESIS	184	-0.4272385 22	-1.8775815 28	4.43495365756476e-07	2.77184603597797e-06	1.51722098811426e-06	28 6 6	tags=41%, list=19%, signal=34%	T1/ACAA1/GOT2/ACADM/CYB5A/ALAS1/ETFDH/OAT/ACAA2/ALDH6A1/PDK4 ECH1/PPM1B/CD36/ABCA1/RNF11/AIFM1/ITSN1/DDT/ELOVL6/STOM/PEX14/GBE1/DLD/PRDX3/GHITM/RREB1/IDH1/COQ9/MCCC1/RMDN3/ADIPOR2/GPAM/SOWAHC/SORBS1/DECR1/NKIRAS1/FAH/LIPE/RETSAT/NDUFA5/ITGA7/SDHB/ACADS/CRAT/PHYH/REEP6/ORM1/SOD1/IFNGR1/SLC5A6/FZD4/LPL/HIBCH/ECHS1/DNAJB9/TOB1/TST/SULT1A1/DBT/QDPR/COL15A1/C3/PGM1/HADH/BCKDHA/CPT2/POR/CMBL/LIFR/ACOX1/CD302/PEMT/GPHN/ANGPTL4/ACADM/MYLK/ALDH2/CAT/GADD45A/ACAA2/SCP2/SPARCL1/EPHX2/ACADL/OMD/FABP4
HALLMARK_MITOTIC_SPINDLE	HALLMARK_MITOTIC_SPINDLE	198	0.4786792576733 28	1.8764513414176 9	5.60424384127 28e-07	3.11346880070 711e-06	1.70421450143 968e-06	23 8 0	tags=28%, list=16%, signal=24%	KIF2C/PLK1/BIRC5/ANLN/KIF3C/KIF23/KIF4A/PIF1/CENPF/KIF15/TTK/TOP2A/CDK1/NEK2/DLGAP5/CCNB2/BUB1/TPX2/KIF11/ARHGEF2/CENPE/NDC80/ECT2/KNTC1/RHOF/RACGAP1/LMNB1/PRC1/NCK2/NUSAP1/ARHGAP4/MARCKS/FSCN1/ESPL1/CEP131/MID1IP1/CLIP2/CEP72/WASF1/PLEKHG2/CENPJ/KIF20B/ARHGEF3/SAC3D1/TUBA4A/FBXO5/FGD6/ABR/MAPRE1/CDC42EP1/SASS6/AURKA/FLNA/BRCA2/INCENP/SMC4
HALLMARK_PEROXISOME	HALLMARK_PEROXISOME	99	-0.5040885 86	-2.0526013 81	1.29088753876461e-06	6.30905827136743e-06	3.45337926432743e-06	26 4 4	tags=45%, list=18%, signal=38%	FIS1/PEX14/ELOVL5/DHRS3/PEX13/IDH1/RDH11/SOD2/ALDH1A1/ABCB1/ISOC1/STS/HSD17B11/RETSAT/CTPS1/PEX11A/DIO1/CRAT/GSTK1/HMGCL/SOD1/ECI2/SLC23A2/ALDH9A1/CADM1/HSD17B4/ALB/ACSL5/SERPINA6/LONP2/ACOX1/ACAA1/MLYCD/CAT/ACSL1/SCP2/EPHX2/SLC27A2/NR1I2/EHHADH/TTR/ABCB4/RXRG/UGT2B17/HAO2

HALLMARK_MYC_TARGETS_V1	HALLMARK_MYC_TARGETS_V1	192	0.468548217057925	1.8299648257093	1.38799281970083e-06	6.30905827136743e-06	3.45337926432743e-06	53 09	tags=56%, list=35%, signal=37%	CDC20/MCM2/CDC45/MCM4/MAD2L1/MCM6/KPNA2/TYMS/NOP56/RFC4/MCM7/NME1/FBL/NAP1L1/SNRPD1/MCM5/SNRPD2/CDK4/PABPC1/CAD/SNRPA/TRIM28/SRM/CCT5/RPL14/RAN/IMPDH2/CCT3/RPS2/EIF3B/RPS3/PCNA/NPM1/SNRPA1/RPS5/LSM7/PA2G4/RPS10/ODC1/TFDP1/CSTF2/RPLP0/CDK2/ILF2/RPL18/CCT2/HSP90AB1/HDDC2/CYC1/SMARCC1/LSM2/RRP9/CBX3/HDAC2/NCBP2/UBA2/RPL6/XPOT/EIF2S2/KPNB1/USP1/CCNA2/PPIA/PPM1G/UBE2E1/HSPE1/GNL3/RANBP1/SNRPG/SRPK1/MRPL9/UBE2L3/PRPF31/TXNL4A/PSMB3/RNPS1/SSB/RPS6/EIF3D/PSMD14/PABPC4/EXOSC7/RRM1/RUVBL2/SNRPB2/XRCC6/MRPL23/IFRD1/YWHAQ/HNRNPA3/HNRNPA1/CCT7/SET/VDAC1/BUB3/HNRNPU/EEF1B2/NOP16/PSMC4/COPS5/HSPD1/PGK1/CCT4/SNRPD3/PTGES3/HNRNPD/SRSF1/CANX
HALLMARK_ESTROGEN_RESPONSE_LATE	HALLMARK_ESTROGEN_RESPONSE_LATE	177	0.420141560703202 2	1.6287099859117 6	0.00039020822298523 4	0.00162586759577181	0.00088994857873825 4	120 02	tags=19%, list=8%, signal=18%	AGR2/PKP3/KRT19/CLIC3/LAMC2/PTGES/S100A9/IGSF1/TNNC1/TFF3/CDC20/CYP26B1/SFN/GJB3/CDC6/TMPRSS3/MAPK13/KIF20A/TOP2A/TPBG/MDK/MYB/NBL1/SULT2B1/FGFR3/HSPB8/HR/FABP5/STIL/ALDH3B1/ST14/ABCA3/PLK4/CD44
HALLMARK_ANDROGEN_RESPONSE	HALLMARK_ANDROGEN_RESPONSE	92	-0.417661043	-1.6748420 81	0.00141483220	0.00544166234	0.00297859412	26 87	tags=42%, list=18%,	LMAN1/CCND1/ELOVL5/ANKH/HMGCS1/HSD17B14/MAF/UAP1/NKX3-1/NCOA4/SEC24D/PTPN21/MAP7/B2M/MERTK/TMPRSS2/HERC3/SAT1/PTK2B/PDLIM5/FKBP5/SLC38A2/TSC22D1/DNAJB9/ELL2/

					999 489	613 418	630 503		signal =35%	SGK1/HPGD/IQGAP2/ALDH1A3/ABHD2/ADAMTS1/HOMER2/LIFR/STEAP4/CDC14B/SORD/AKAP12/INSIG1/AZGP1
HALLMARK_GLYCOLYSIS	HALLMARK_GLYCOLYSIS	188	0.3 905 092 915 601 07	1.5 179 575 003 743 5	0.00 245 605 935 050 394	0.00 877 164 053 751 407	0.00 480 131 903 106 033	2 2 3 1	tags=27%, list=15%, signal =23%	HS6ST2/PPFIA4/G6PD/SLC16A3/PKM/GAL3ST1/TFF3/EGLN3/GPC4/PFKP/HK2/MIOX/CENPA/ENO2/KIF20A/QSOX1/B3GNT3/SOX9/TPBG/CDK1/ADORA2B/VLDLR/ARTN/EFNA3/GPC3/STC2/ALDOA/DEPDC1/DPYSL4/TGFA/CHST1/IER3/CD44/STMN1/DSC2/HOMER1/GNPDA1/ENO1/HMMR/ELF3/SPAG4/PYGB/AGRN/BIK/PLOD2/AURKA/IGFBP3/RBCK1/RRAGD/MIF
HALLMARK_INTERFERON_ALPHA_RESPONSE	HALLMARK_INTERFERON_ALPHA_RESPONSE	95	-0.3 838 020 96	-1.5 472 024 75	0.00 775 307 795 593 527	0.02 422 836 861 229 77	0.01 326 184 387 199 45	3 0 8 0	tags=38%, list=20%, signal =30%	TRIM5/PARP14/ELF1/UBE2L6/OAS1/RTP4/TRIM26/HLA-C/BST2/IRF2/UBA7/IFIT2/TMEM140/HELZ2/GMPR/IFIH1/PARP9/EPSTI1/IFIT3/USP18/DHX58/IFITM1/B2M/ISG15/MX1/LAP3/RSAD2/IFI44/CMPK2/DDX60/IFI44L/HERC6/OASL/TXNIP/C1S/IFI27
HALLMARK_INTERFERON_GAMMA_RESPONSE	HALLMARK_INTERFERON_GAMMA_RESPONSE	193	-0.3 148 871 47	-1.3 970 249 33	0.00 756 256 644 982 824	0.02 422 836 861 229 77	0.01 326 184 387 199 45	2 7 4 6	tags=28%, list=18%, signal =23%	SOCS3/CD40/BST2/IRF2/IFIT2/SPPL2A/IRF4/HELZ2/ITGB7/CFB/MYD88/IFIH1/SOD2/IRF8/EPSTI1/LATS2/IFIT3/NFKBIA/ISOC1/PDE4B/IL6/TNFSF10/USP18/DHX58/B2M/ISG15/MX1/LAP3/CD69/APOL6/P2RY14/RSAD2/PTGS2/OAS2/IFI44/XAF1/AUTS2/CFH/CMPK2/DDX60/IFI44L/NAMPT/SELP/HERC6/IFIT1/OASL/TXNIP/C1R/GCH1/FAS/C1S/SERPING1/IFI27/MT2A
HALLMARK_SPERMATOGENESIS	HALLMARK_SPERMATOGENESIS	83	0.4 215 226 444	1.4 652 152 917 165	0.01 146 788 474	0.03 372 907 278	0.01 846 222 931	1 4 5 4	tags=24%, list=10%,	GAD1/KIF2C/MLF1/TTK/CDK1/PCSK1N/NEK2/NCAPH/CCNB2/BUB1/IL13RA2/NEFH/CDKN3/CLGN/RPL39L/EZH2/RFC4/CNIH2/CFTR/DMC1

			551 74		744 75	661 04	477 62		signal =22%	
HALLMARK_EPITHELIAL_MESENCHYMAL_TRANSITION	HALLMARK_EPITHELIAL_MESENCHYMAL_TRANSITION	19 2	0.3 618 676 028 550 17	1.4 133 123 565 095	0.01 291 082 718 233 05	0.03 586 340 883 980 68	0.01 963 049 747 021	21 5 7	tags=27%, list=14%, signal =23%	DKK1/LAMC2/SLC6A8/CXCL1/MMP1/PTHLH/CTHRC1/LAMA1/APLP1/FBLN1/ENO2/CXCL6/QSOX1/OXTR/PFN2/COL11A1/PMEPA1/SPP1/CDH6/SERPINE2/CAPG/GPX7/MATN3/MMP14/TNFRSF11B/FBN2/TPM2/CXCL8/CD44/EMP3/MCM7/GLIPR1/SERPINH1/TGFB1/PLAUR/DAB2/ADAM12/COMP/NTM/LGALS1/MAGEE1/LAMC1/ITGAV/RGS4/PDLIM4/TPM4/COL8A2/PLOD2/ITGA2/IGFBP3/FLNA

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Table S5. Correlation analysis of prognostic genes and immune checkpoints.

	checkpoint	gene	r	p
1	SLC26A6	CD27	-0.005518841	0.91654547504406
2	TYRO3	CD27	0.263352418550811	3.57370028004346e-07
3	PDK4	CD27	-0.255106772	8.41861630569035e-07
4	SLC26A6	CD44	0.0649433480221028	0.217064007797412
5	TYRO3	CD44	0.212224504038435	4.58174719225868e-05
6	PDK4	CD44	-0.138059338	0.00844014348806944
7	SLC26A6	CD70	0.0816090444183477	0.120641099228529
8	TYRO3	CD70	0.300908548900571	4.93279717086106e-09
9	PDK4	CD70	-0.327777122	1.54213340392969e-10
10	SLC26A6	CD80	0.0355979926409862	0.498972108940596
11	TYRO3	CD80	0.397539894772496	3.40914824611255e-15
12	PDK4	CD80	-0.207406709	6.85172890876561e-05
13	SLC26A6	CD86	0.00648798715097058	0.901958454305715
14	TYRO3	CD86	0.374282673629735	1.62787150422389e-13
15	PDK4	CD86	-0.239999077	3.75340960468096e-06
16	SLC26A6	CTLA4	0.157911598893469	0.00255125128583049
17	TYRO3	CTLA4	0.330909838595776	1.00633703458066e-10
18	PDK4	CTLA4	-0.346282361	1.15367875290727e-11
19	SLC26A6	HHLA2	0.24718601395817	1.8655721933777e-06
20	TYRO3	HHLA2	0.318831989973414	5.08060978063506e-10
21	PDK4	HHLA2	-0.202989761	9.82965360015074e-05
22	SLC26A6	ICOS	0.0854706848171356	0.103993265592392
23	TYRO3	ICOS	0.264953013914866	3.01581625882253e-07
24	PDK4	ICOS	-0.294497706	1.07214687495684e-08
25	SLC26A6	IDO2	-0.10512074	0.0453428623158632
26	TYRO3	IDO2	-0.217039421	3.03645911802237e-05
27	PDK4	IDO2	0.260596279288809	4.77438779907504e-07
28	SLC26A6	KIR3DL1	-0.121915433	0.020154293922675
29	TYRO3	KIR3DL1	-0.006971592	0.894691518234035
30	PDK4	KIR3DL1	0.190286722864052	0.000266027384968637
31	SLC26A6	LAG3	0.0498559702477332	0.343538496124753
32	TYRO3	LAG3	0.193953710779427	0.000200858371022949
33	PDK4	LAG3	-0.230099383	9.4924260546221e-06
34	SLC26A6	LAIR1	0.0994021046758365	0.0584882089597017
35	TYRO3	LAIR1	0.383103837398162	3.89438131905722e-14
36	PDK4	LAIR1	-0.233007826	7.25794289429905e-06
37	SLC26A6	LGALS9	0.0454831456840498	0.387572100323817
38	TYRO3	LGALS9	0.510410483539565	1.79050460398271e-25

39	PDK4	LGALS9	-0.401552992	1.69544824986643e-15
40	SLC26A6	NRP1	0.00220071239659386	0.966670380254964
41	TYRO3	NRP1	0.350222103361229	6.49500174683388e-12
42	PDK4	NRP1	0.0362001132970495	0.491735328840784
43	SLC26A6	TIGIT	0.0423122833971654	0.421548969129256
44	TYRO3	TIGIT	0.263157485407611	3.6480644139149e-07
45	PDK4	TIGIT	-0.25819384	6.12930171401659e-07
46	SLC26A6	TNFRSF14	0.227912720127688	1.15883971908142e-05
47	TYRO3	TNFRSF14	0.225397405206546	1.45427188045977e-05
48	PDK4	TNFRSF14	-0.209197884	5.90594494242464e-05
49	SLC26A6	TNFRSF18	0.179392430773646	0.000594755587857268
50	TYRO3	TNFRSF18	0.429465311183041	1.00593076926482e-17
51	PDK4	TNFRSF18	-0.483058127	1.27444021711643e-22
52	SLC26A6	TNFRSF25	0.105572227872579	0.0444201594414819
53	TYRO3	TNFRSF25	0.295288087101246	9.75287797243889e-09
54	PDK4	TNFRSF25	-0.111650028	0.0334587423198807
55	SLC26A6	TNFRSF8	-0.016452913	0.754728881687575
56	TYRO3	TNFRSF8	0.389016656125568	1.4569509032222e-14
57	PDK4	TNFRSF8	-0.275089871	1.00290844067867e-07
58	SLC26A6	TNFRSF9	0.120713821766841	0.0214259707489257
59	TYRO3	TNFRSF9	0.2987929445725	6.38665088317094e-09
60	PDK4	TNFRSF9	-0.181786115	0.000500312539622897
61	SLC26A6	TNFSF15	0.0664165066475463	0.206792537715776
62	TYRO3	TNFSF15	0.528611017310164	1.6117940647738e-27
63	PDK4	TNFSF15	-0.415912064	1.28739236851127e-16
64	SLC26A6	TNFSF4	0.227740867871456	1.17705584992064e-05
65	TYRO3	TNFSF4	0.426821295229131	1.66912026083949e-17
66	PDK4	TNFSF4	-0.145562624	0.005459552558813
67	SLC26A6	TNFSF9	0.166998247851167	0.0014069442462353
68	TYRO3	TNFSF9	0.422397459891059	3.85616160931202e-17
69	PDK4	TNFSF9	-0.260963755	4.59438427199085e-07

SUPPLEMENTARY FIGURE LEGENDS

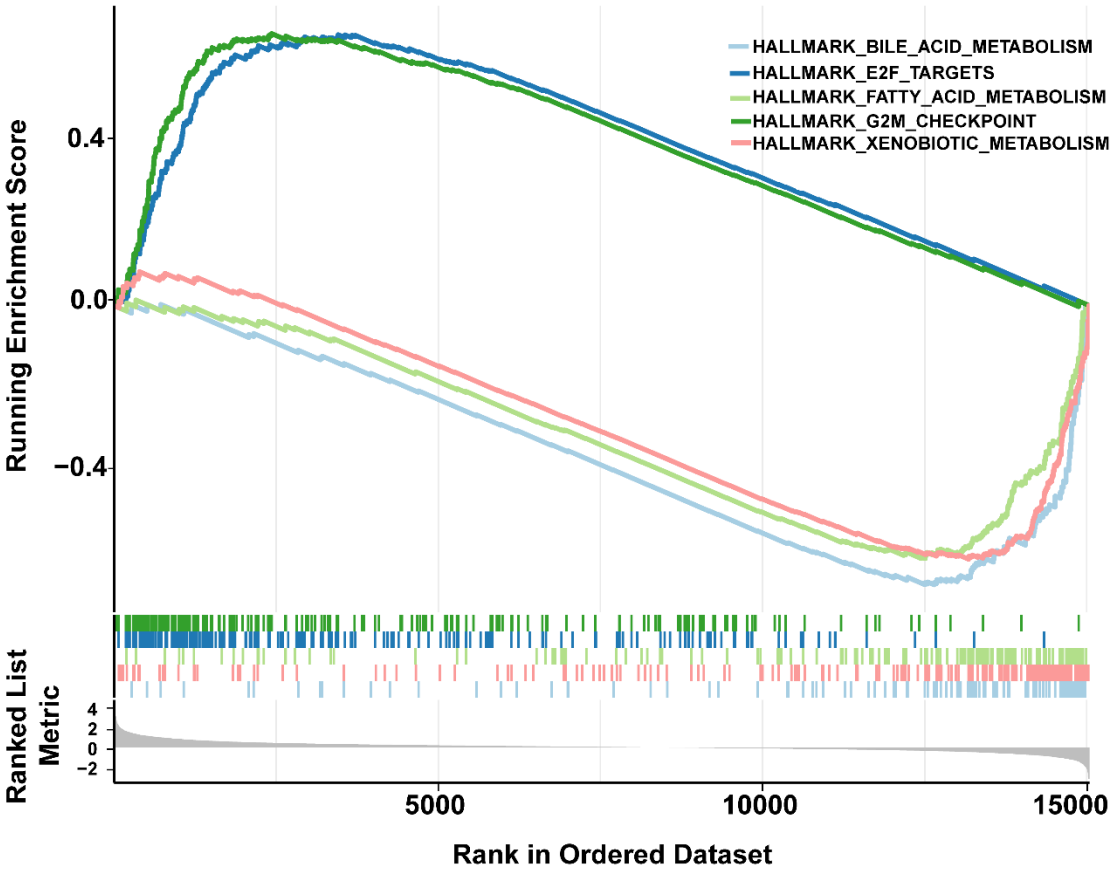
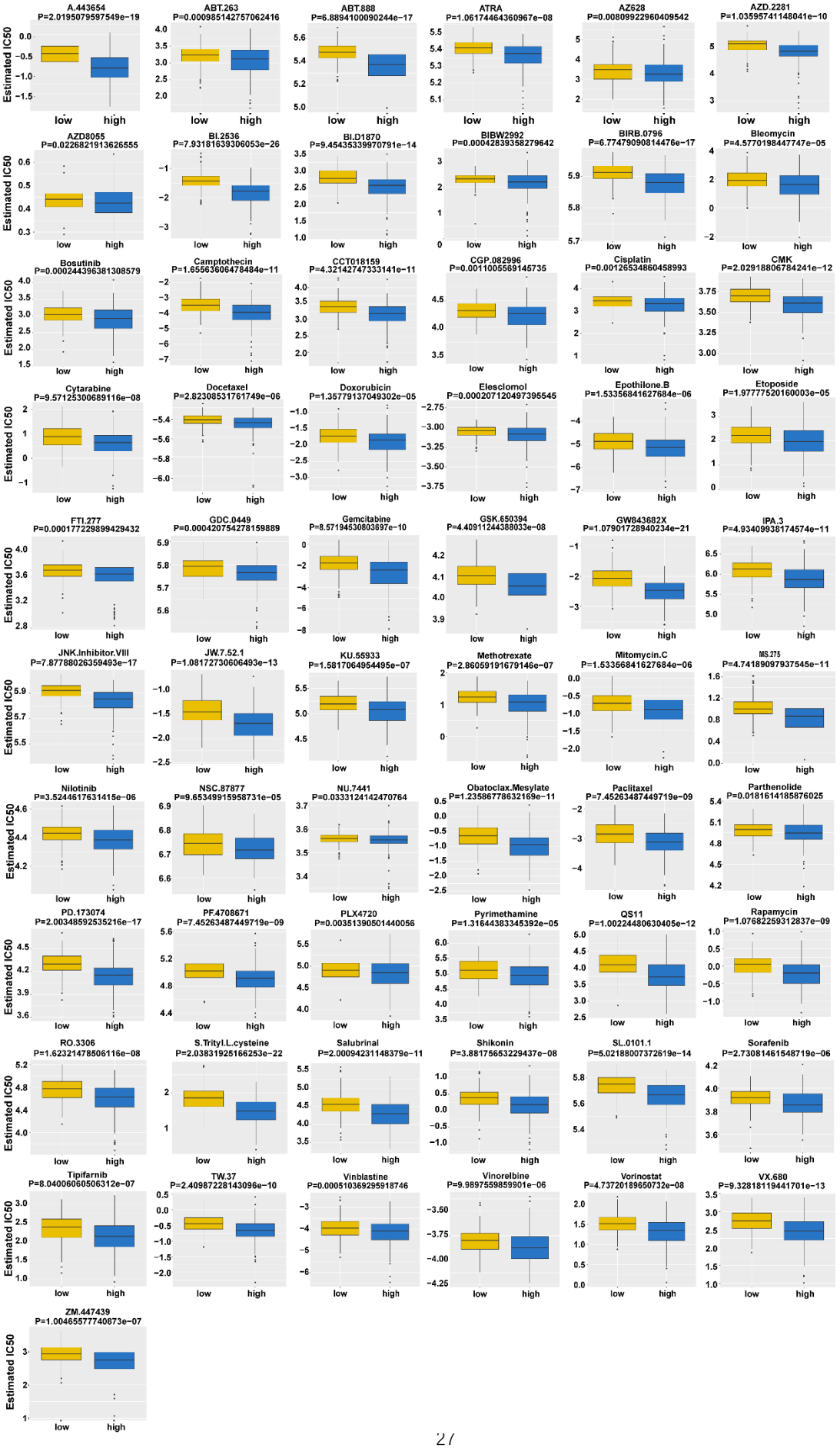


Fig. S1 Enrichment pathway analysis of Hallmark.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ATRA
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AZ628
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AZD.2281
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BI.D1870
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P=0.000428393582 79642
BIRB.0796
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Bleomycin
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Bosutinib
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Camptothecin
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Cisplatin
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Doxorubicin
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Epothilone.B
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Gemcitabine
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GSK.650394
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Shikonin
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Sorafenib
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Tipifarnib
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TW.37
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Vinorelbine
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Vorinostat
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Estimated IC50
low
high

Fig. S2. IC50 values of 61 drugs differ significantly between distinct risk groups ($P < 0.05$).

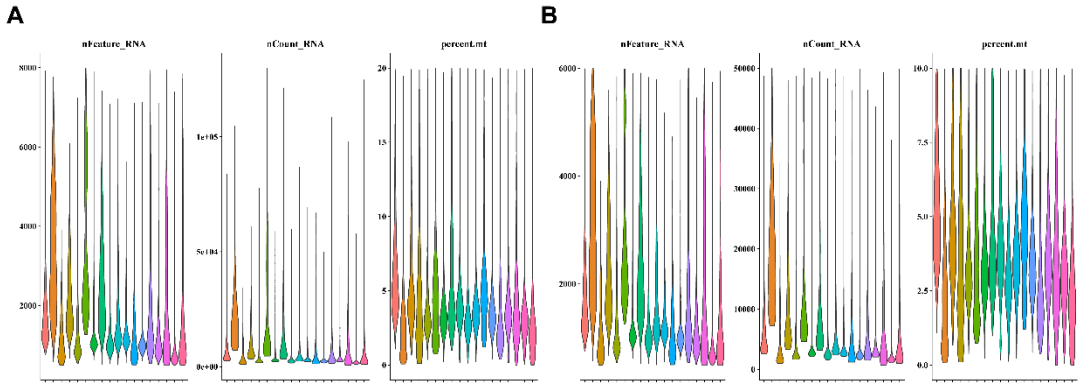

Fig. S3. Violin plots of nFeature_RNA, nCount_RNA and percent_mt before and after quality control of single-cell data. A. Violin plot before quality control. B. Violin plot after quality control.